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NEW YORK, SATURDAY, DECEMBER 30, 1899.

CONTENTS.

	Page
Editorial	995
New Rates for Telephone Service in New York	998
Tariff on Electricity from Canada	998
Canadian Water Power Electrical Plants—XI. The Chambly Transmission Plant, by E. M. Archibald	999
Death by Electricity, by R. H. Cunningham, M. D.	1003
The Lachine Rapids Power Plant	1004
Electric Plant of the Ohio University, by Burcham Harding	1005
Storage Batteries and Isolated Plants, by Alton D. Adams	1007
The Obsolete in Telephone Work, by N. H. Holland	1009
Buildings and Plant for the Pan-American Exposition	1009
Examination for City Electrical Inspector	1010
Trolley and Steam Competition in New York State	1010
Some New Telephone Patents	1011
Consolidation of the Havana Street Railways	1011
Current News and Notes	1012
LETTERS TO THE EDITORS:	
Alternating Current Series Arc Lighting, by Elihu Thomson	1013
Professional Degrees, by Frank Brioli	1014
Digest of Electrical Literature, Compiled by Carl Hering	1014
New Book	1019
Directory of Societies	1019
Federal Salts in Open Circuit Batteries Compared with Sal Ammoniac	1019
A Large Rushmore Multivoltage Plant	1020
Vehicles of the General Electric Automobile Company	1021
DEPARTMENTS:	
Financial Intelligence	1022
Commercial Intelligence	1022
Special Correspondence	1024
General News	1027
Personal	1029
Obituary	1029
Trade and Industrial Notes	1029
Record of Electrical Patents	1030

CONTENTS AND INDEX.

The present issue, closing the thirty-fourth volume of this journal, is singular in being the twenty-seventh number of the volume, and the fact that it thus falls between two long holidays, has rendered it very inconvenient to issue our Index of Contents in the usual manner with the close of the year. The Index is prepared with a great deal of care as to cross references and general completeness, and the extra number thrown in by the run of the weeks has complicated matters. In order to print our regular issues at the proper time, despite their bulk and the interference of the holiday season, the appearance of the Index is deferred until after the issue of our Export number, and it will accompany the second issue in January. To give some idea of the work involved in a detailed index such as it has been the practice to give with this journal, it may be noted that the volume now closing is by far the largest in the long series. The volume for the second half of 1898, with which alone it can be compared, contained an average of twenty-eight pages of text per issue. The present volume, being the first complete volume of the consolidated papers, has contained an average of no fewer than thirty-eight pages per issue, or nearly forty pages per issue if the extra twenty-seventh number were disregarded; the total of pages mounting above 1000. This increase of about 35 per cent. in the amount of reading matter furnished to our readers, without any increase in price, is one exemplification of the better service that was aimed at and promised when the two constituent papers were brought together early in the present year.

RETROSPECT AND PROSPECT.

The year which closes this week has probably been one of the most active ever seen in electrical industries in this country, as it has been in almost every other branch of trade, commerce and manufactures. There has been no line of production in the electrical field that has not been as busy as it could be throughout 1899. The older utilizations of electricity have been prosperous while the newer ones have taken on bulk and shape in the most encouraging manner. As a matter of fact, the net scientific gain of the year has been small, but it is never very significant in such times of intense commercial activity.

That the activity thus made manifest during the year will continue in 1900, there is no good reason to doubt. Many of the influences that stimulate production have not yet been fully developed and some of the influences that check production have been widely felt. The prices of copper, steel and iron have been abnormally high, preventing a full satisfaction of the need for electrical apparatus, yet an enormous quantity of generators and motors have been built, causing now in turn a permanent and steadily larger demand for all the devices and appliances that depend upon a cheaper and more general supply of current. To go no further than New York, the recent and prospective increases in the generator capacity are on such a colossal scale as to make all the previous equipments look very small. And it is so all over the country.

Other departments of electricity have also seen a very busy year, with the prospect of a much busier one to follow. Telephony, for example, so far from being fully developed, is but just now realizing the measure of its opportunities, and between the determination of the Bell companies to hold their own and the resolve of the inde-

pendents to cultivate a large part of the field for themselves, a height of development and expansion has been reached which bids fair to double and quadruple the existing system within a mere year or two. While this growth on the old flat rate plan would have been self-retarding and would have brought with it no cheapening of service, the newer basis of metering calls is becoming so universal as to push the bounds of growth beyond the calculable point.

Automobilism is perhaps the art that has most enlarged the use of electricity during 1899. And yet the work has been largely tentative and experimental. No one familiar with the situation can question for a moment the rapid growth of this industry, not wholly, it may be, on electrical lines, but looking to electricity for some of the best and most profitable developments. It takes time to break away from traditional forms and ideas, but proof positive as automobilism now is of that fact, it is not less evident that the cumulative changes and improvements are bringing about a very rapid advance which when looked upon from the distance of a few years hence will then be seen to have been revolutionary.

Now on the very frontier of discovery and utilization, the etheric or wireless telegraph of 1899 may be found next year one of the most swiftly advancing of the newer electrical arts. So far, it has been gloriously well advertised, but it has next to show that it is no toy or marvel, but a distinct addition to the implements with which mankind annihilates space and promotes the civilization which in its last analysis depends so much on the swift exchange of thought and intelligence. A more delicate tool than the coherer the electrician has never handled, but he must show what he can accomplish with it, and 1900 should be prolific in demonstrations of that character.

In the realm of pure science the announcement by Kelvin of a new phenomenon appearing to reveal a direct relation between magnetism and molecular rotation, attracted momentary attention. It was soon, however, recognized to be only a theoretical deduction and not an experimental observation. Preparatory to the meeting next year of an international electrical congress at Paris, the question of a rational system of electrical magnetic units has during the year been brought to the front and the discussion, it is hoped, may bear fruit in a definitive rational system to replace the present irrational system of so-called practical units. The most interesting development of the year in the way of new apparatus has been the discovery of the electrolytic interrupter, one form by Wehnelt and the other by Caldwell—a discovery particularly apropos in view of the important part which the induction coil has played since the great discovery of Röntgen.

FULTON AND HENRY.

About a year from now the American Society of Mechanical Engineers will honor itself by honoring the memory and the remains of Robert Fulton. The dust of the great engineer, now lying in the Livingston vault in Trinity churchyard, a stone's throw from this office, is to be reburied in a stately, granite sarcophagus, with appropriate inscription, and the ceremonies will occur during the Society's annual meeting next December, when the required fund of about $3000 will have been fully raised; indeed, even more may then be in hand.

We are glad to note this exhibition of filial piety on the part of our engineering cousins, the mechanicals, and venture to believe that some of the electricals will be glad to participate actively in this movement. There is, however, an anniversary more strictly electrical which deserves to be signalized, and which, in Albany at least, has not been allowed to go by unnoticed. We refer to the one hundred and second birthday anniversary of Joseph Henry, the great Albanian, who as an electrician ranks hardly second to Franklin and whose modest, quiet life was interspersed with momentous discoveries in electricity and physics. At the present time Albany, although it has a fine statue of Robert Burns, is without a monument to her own distinguished son, and it is to be hoped that the recent exercises there will have done something to remove the reproach. The American Institute of Electrical Engineers, which was so active in getting Henry's name attached to the unit of self-induction, might well lend a hand to our Albany friends in this matter.

PROFESSIONAL VERSUS INDUSTRIAL EDUCATION.

The distinction has long been recognized on the Continent of Europe between educational courses designed to fit young men for a profession, and those having for an object the training of young men for such positions as foremen and superintendents of workshops, construction, etc. In this country such a distinction is rarely drawn, and to this may be ascribed the criticisms so frequently levelled at the courses in our technical schools. On the one hand there are those who would reduce practical work in such schools to a minimum just sufficient to illustrate the application of principles. They maintain that the practical instruction imparted at college must necessarily be of a somewhat perfunctory nature; that the graduate can apply but a very small portion of such practical knowledge in any position into which he may come upon leaving school, and even that small portion would have little actual value. Moreover, the time spent in practical work might much better be employed in systematic intellectual training and in inculcation of principle, as the opportunity to continue systematic study rarely comes in after life. On the other hand are those who consider that a graduate from a technical school should be taught sufficient practice to have a wage-earning capacity upon graduation, and that the greater his knowledge of manual dexterity, the better the engineer he is apt to be.

While the latter may have no thought that a course such as he considers the ideal one for the engineer is to a great extent the equivalent of the European industrial course as distinguished from a professional one, yet such is the case. The time appears to be drawing near when the actual differentiation will be made, and then we shall finally have engineering education, in both senses, placed on a basis which will relieve our technical schools of much of the criticism from all sides to which they are subject at present. A paper read before the recent annual meeting of the American Society of Mechanical Engineers lays down a systematic course of industrial education which appears to offer a very satisfactory solution to the question. The author apparently had not in mind the distinction above referred to between two separate courses each aiming at a well-defined object, for he evidently has a poor opinion of the higher courses of engineering instruction for the education of engineers. The statement is made that a man ought to be a thorough mechanic before he can be a well-trained mechanical engineer, that he must be able to do the work, and this the present technical school does not teach thoroughly. He considers that the technical school overlooks the needs of the large body of mechanics and devotes itself to the scientific professionalists. He believes that those educated in higher engineering science are fitted to deal with pure unapplied science, that their work is original research and that they have nothing to do with mechanical difficulties. He therefore proposes a system of schools whose aim is to fit each boy for the successive grades of mechanic from machinist up, so that any time he will be fitted to take up his work outside as a well-trained mechanic in the grade which he has completed, and be prepared to enter the training of the next grade. That is, the object of the school is to produce many well-trained and educated machinists, and from these machinists some foremen, and from the foremen a few superintendents, and

finally an occasional engineer. Such a school would be to a certain extent the counterpart of the continental industrial school, and should accomplish an excellent object. Of recent years there has been a decided trend toward industrial education in this country, as exemplified by such institutions as the Pratt Institute in Brooklyn, the Spring Garden Institute in Philadelphia and similar schools in other large cities.

While acknowledging the usefulness of such a system of technical instruction as proposed, it does not follow that the real professional school is lacking in any respect. From the latter will be drawn the men for the upper branches of engineering work, requiring an intellectual training and broad knowledge incompatible with the qualities necessary in a foreman or superintendent whose work lies in detail and routine. This difference between men of the two trainings was one time spoken of in an address by the late Hon. Eckley Coxe, a large employer of technical men. Of young men entering his employ, he noted that those of practical training took the lead for the first few years, but that the college graduate almost invariably forged ahead thereafter. The fact that positions in the higher ranks of engineering are relatively few in number is more than compensated for by the flexibility which accompanies higher education, rendering its possessor able to embrace opportunities for advancement in lines having little or no connection with that along which he was technically educated. The alumni registers of our better class of technical schools show the widest diversity of occupations, and even a cursory glance over the electrical field will indicate that electrical engineering graduates are becoming as plentiful in the administrative and commercial as in the engineering department.

DEATH BY ELECTRICITY.

An interesting and important article appears on the above subject this week. It is virtually an abstract from a paper by the same author that has recently appeared in the New York *Medical Journal,* and the author has endeavored to filter the paper through a medical-term-absorbing-medium so that the abstract offers no difficulty to assimilation by the layman. Dr. Cunningham has evidently taken great pains to determine the cause of death in dogs killed by electricity, and we think he is entitled to much credit for his painstaking research, and for the apparently impartial statement of its results. How such results could have given rise to the statements that appeared in the New York daily press some months ago it is hard to imagine. The only inference is that with the daily press all things are possible.

The important generalization to which the paper leads is that under ordinary circumstances of electric shock by contact with high pressures, death is produced by disorganizing the action of the heart, which stops throbbing rhythmically, and is thrown into a trembling or quivering like a vessel caught in stays when going about. Strangely enough, it seems that the human heart, with all its wonted capabilities for response, is incapable of automatically restoring its measured cadence when once thrown into shivering, and that proper external stimulus must be administered before the discordant muscular action can be co-ordinated and the master muscle resumes the even tenor of its way. Moreover, any effective external stimulus must come, it seems, within a few minutes or the arrested circulation will have starved the more delicate central nervous mechanism into death. After that no efforts at artificial respiration, nor efforts at resuscitation of any kind, can bring the sufferer back to life.

Assuming that Dr. Cunningham's experiments will be corroborated and his conclusions sustained, the result is of great importance. It would mean that in the vast majority of instances all attempts at artificial respiration must be nugatory. The best that the article says for such attempts is that they can do no harm, which is cold comfort to the bystanders when an accident occurs. If artificial respiration can only avail when the shock has been to the brain, and not to the heart, every effort should be made to discover some practicable means of stimulating the heart and restoring it to its functions. The only physiological method suggested in the paper is attempting artificial circulation. Such method would require the aid of at least two medical experts, with a supply of warm defibrinated blood and a complicated artificial heart and circulatory system. When a single-cylinder engine stops on its centre by an accident, and refuses to start reciprocating, there are means for getting it over the centre. Surely there must be some way of getting a human heart over the centre when demoralized, but not destroyed.

The paper suggests that the required stimulus may possibly be given by a high-pressure momentary electric shock. If it were not for the serious importance of the subject this would suggest the caudal appendage of the canine animal that effected the morsure. Such a procedure would at least have the merit of practicability, for where a man has received a seemingly fatal shock, it is likely to suppose that a duly regulated successor might be forthcoming; but nothing save the most convincing assurances that such a procedure might be successful would induce the friends of an electrically injured man to practice it within the brief interval when the heart must either start, or stay forever at rest.

Electricity has come to stay with us, and we must live with it, were it a far more dangerous guest than it really is. With care, dangerous electric shocks need be but few and far between. But accidents will sometimes happen, even in the best regulated central stations, and it is of great importance to know the physiological nature of the danger and the proper means to adopt when danger is present. Elaborate instructions for practicing artificial respiration in cases of electric shock are to be found in central stations all over the land. If Dr. Cunningham's experiments on lower animals are applicable to human beings, and his conclusions from them are correct, then the sooner we find a new modus operandi the better; but first, means must be found for restoring the throb to a fibrillating heart.

We think this field of physiological research is a most important one, and we hope that Dr. Cunningham's experiments may not only be repeated with a view to complete verification, but that means may be found for restoring the functions of the arrested heart in cases of accidental shock. This is a much more important question than that of the exact moment at which death is brought about in electrocution. To the layman, death occurs when consciousness ceases beyond actual restoration. To the physiologist complete death occurs only with the destruction of every individual organic cell in the body. It is impossible for the two to understand each other, with meanings so different for the same term. To the physiologist, electricity can only produce instanteous death by a shock so violent as would practically mean blowing the body to atoms. To the layman, electricity cannot fail to produce instantaneous death when it immediately robs of consciousness never to be restored. When the academic restrictions to the question are set aside, no misunderstanding remains. There is no difficulty in administering death by electricity. What we want is a safe means of restoring to life the few unfortunates who may receive severe accidental shocks.

New Rates for Telephone Service in New York.

On January 1, 1900, the New York Telephone Company puts in force the following schedule of message rates for telephone service in the borough of Manhattan. The rates apply to party line stations, two stations on a line:

Number of messages to be sent in one year.	Annual Rate.	Additional Local Messages.
600	$ 60	8 cents.
800	75	8 cents.
1000	87	8 cents.
1200	99	7 cents.
1500	117	7 cents.
1800	135	6 cents.

This new schedule, which offers a minimum rate of $60 a year, or $5 a month, for 600 local messages, is in line with the policy pursued by the New York Telephone Company since the introduction of message rates in 1894 of reducing the rates, as experience showed any reduction or modification to be practicable. The introduction of two-party line service in Manhattan is largely due at the present time to the extensive progress made with the installation of the common battery or relay system in the equipment of the New York Telephone Company's exchanges. One of the various novel features of the relay switchboard is a selective signalling device which enables either station on a two-party line to be rung up without making a sound on the bell of the other. This, of course, provides a satisfactory party line service for moderate users, as the principal disadvantage of party line service has hitherto been the ringing of both bells whenever either subscriber was called by the exchange. There will still remain the fact that two parties connected to a single telephone line cannot both use it at once, but since this class of service is principally directed to moderate users, this should offer no great hindrance to its extensive adoption, in view of the cheap rate at which it allows New York telephone service, with its rapid communication and vast facilities, to be supplied.

The steady reduction of rates made by the New York Telephone Company and the extensive publicity in which it has indulged during the past few years have resulted in a very rapid growth of the system. The number of telephone stations added to the New York Company's system in Manhattan and the Bronx during the year 1899 was about 10,500, or, rather, more than the total number of telephone stations in old New York City in the middle of 1894, when the Metropolitan Telephone & Telegraph Company had been in existence for over fifteen years. In five years after the introduction of message rates the New York Telephone Company more than trebled its system, and the increase has been at a sharply increasing rate, as shown by the enormous gain of the past year.

It is well known that the New York Telephone Company has been engaged for some time past in converting all its exchanges to the relay system of equipment. The ELECTRICAL WORLD AND ENGINEER has published at various times references to the progress of this work. The exchanges in the upper part of the city, Harlem, Riverside, Seventy-ninth street and Madison Square are already operating on the relay system, and the new exchange at Fifty-eighth street will shortly be put in operation, so that in the course of the coming year practically the whole of the residence district of Manhattan Island will be operated by the relay system. The relay equipment at John street, the new telephone building put up a few years ago in Gold street to provide for the rapid growth of the telephone service in the lower part of the city, will start the operation of its new installation serving an enlarged district, at the beginning of the year. Between 1000 and 1200 subscribers' lines are transferred from Cortlandt street to John street, so that some 2700 downtown subscribers will, from the beginning of 1900, enjoy the benefits of the improved service given by the relay system. The John street district has been somewhat enlarged, so that it is now bounded by Chambers street and Park Row on the northwest and by Nassau street and Wall street on the west and south.

All indications point to a largely increased rate of growth in the New York Company's system during the coming year. The recent reductions in rates have greatly accelerated the increase in the system, and it is expected that the new rates will create additional impetus. Liberal measures have been taken to provide for an increase in lines and stations at least 50 per cent. greater than that of 1899. The existing telephone buildings in various parts of the city are being rearranged and enlarged and a new building at Fifty-eighth street and another at Eighteenth street are in course of construction. A substantial addition is being made to the Cortlandt street building, and a large new exchange on the relay system will be constructed there when the new building now in course of erection on the east of the present telephone headquarters is completed.

In thus providing for the increase of the metropolitan part of the city the New York Telephone Company has not neglected its country territory served by the Westchester division, which provides telephone service in Westchester County, Rockland County and Greenwich, Conn. New rates embodying very attractive figures for those residing and doing business in the suburban towns to the north of New York have been adopted during the past year. The exchanges and the plant generally have been entirely reconstructed, and the facilities for accommodating new business have been greatly enlarged. In order to provide rapid and direct connection between Westchester County and Rockland County, where the relations are naturally rather intimate, a cable has been laid between Nyack and Dobbs Ferry. This cable gives a direct trunk service between exchanges of Westchester County and the telephone system on the other side of the river, of which Nyack forms the center. It is interesting to note that the route followed by this cable is that of an historic ferry of colonial times, showing that the methods of conducting trade and communication change rather than the directions which they follow.

Tariff on Electricity From Canada.

The officials of the United States Treasury Department are considering a proposition to levy a tariff duty on an electric current generated in Canada and conducted across the border into the United States. The question was raised by the Niagara Falls Power Company, of Niagara Falls, N. Y., against the Ontario Power Company, the rival concern across the river at Niagara Falls, Ont. The Ontario Power Company proposes to extend its lines to as many points as possible in the United States, selling its light and power to as many customers as it can get. This business, of course, competes seriously with that of the American company, and in a communication to the Treasury Department on the subject the officers of the company represent that inasmuch as the electric current is a thing of value, bought and sold, and that since it comes in competition with an American industry, it should be made subject to duty. The Secretary of the Treasury has submitted the question to several leading collectors of customs in various ports of the country with a view to obtaining their opinions.

Several years ago the Assistant Secretary of the Treasury received a letter from a citizen of Watertown, N. Y., saying that he had obtained a concession to build and operate an electrical power plant on the Canadian side of Niagara Falls, and asking if, in case he should transmit the current across the border, he would be compelled to pay tariff charges. He was assured by Assistant Secretary Tichenor, now a member of the Board of General Appraisers in New York, that no tariff duties would be assessed. The present officials of the Treasury Department, however, are strongly inclined to rule otherwise. If it is decided that tariff should be assessed it will be under the authority of the "dragnet clause" of the Dingley law, which makes all unenumerated manufactured articles dutiable at 20 per cent. ad valorem.

The Ontario Power Company, in a communication to the Treasury Department, declares that the electric current cannot be regarded as an "article" within the meaning of the tariff law, despite the representation of the rival American company that electricity is a thing that can be measured as accurately as potatoes or wheat or cotton cloth.

Five or six years ago it was proposed to levy tariff duties on natural gas piped across the Niagara River from Canada, the Treasury Department holding that the gas was "an unenumerated, unmanufactured article" under the McKinley law. The Board of General Appraisers upset this ruling, declaring that gas is not an "article," and on appeal by the government the Supreme Court of the United States upheld the Board of General Appraisers. This year another collector of customs at Buffalo resumed assessment of duties on natural gas, but the Treasury Department ordered him to desist, and the government is now refunding money to the gas company.

Canadian Water Power Electrical Plants.—XI.

THE CHAMBLY TRANSMISSION PLANT.

By E. M. ARCHIBALD.

THE long-expected day of the transmission of electrical power from Chambly to Montreal arrived on Saturday, June 24, when the lines were finally tested, a lamp being lighted at the Chambly power house from the Montreal station. On Sunday, the following day, one of the huge generators was slowly and noiselessly started, the field excited, switches closed and power was successfully transmitted into Montreal. The first use of the power was to test the transformers in the substation, but at 4 p. m. steam was shut off from the engines in the city plant, and until 5:30 p. m. those using the Royal Electric Company's power were, unknown to them, cut off from the city plant and supplied from Chambly, some 16½ miles distant.

The Royal Electric Company has for many years been supplying the great bulk of the electric light and power service in the City of Montreal, Canada, and for this has until the present been utilizing steam power for generating purposes. As early as 1893, however, they secured control of an immense water power situated at Chambly on the Richelieu River, about 15 miles from Montreal. It was found after careful calculation that the cost of water and steam power for the size of the plant necessary—8000-hp—was almost equal, but that for any increase in size, water power decreased at a much more rapid rate than did steam. Consequently, the Chambly Manufacturing Company, the principal directors of which are interested in the Royal Electric Company, having been formed, this water power was sold to it and a contract was drawn up whereby the new company was to supply the Royal Electric Company with a specified amount of power in Montreal, with provision for increase. One of the conditions of the contract is that the steam plant shall remain as at present for two years to provide for possible contingencies.

The hydraulic equipment of this plant has already been very fully described in these columns (issue of June 3), and this article will therefore deal solely with the electrical equipment. This is of special interest in being very complete in all details, and in representing the latest design in high-tension apparatus, as all the electrical apparatus, consisting of the large inductor alternators, the exciters, the

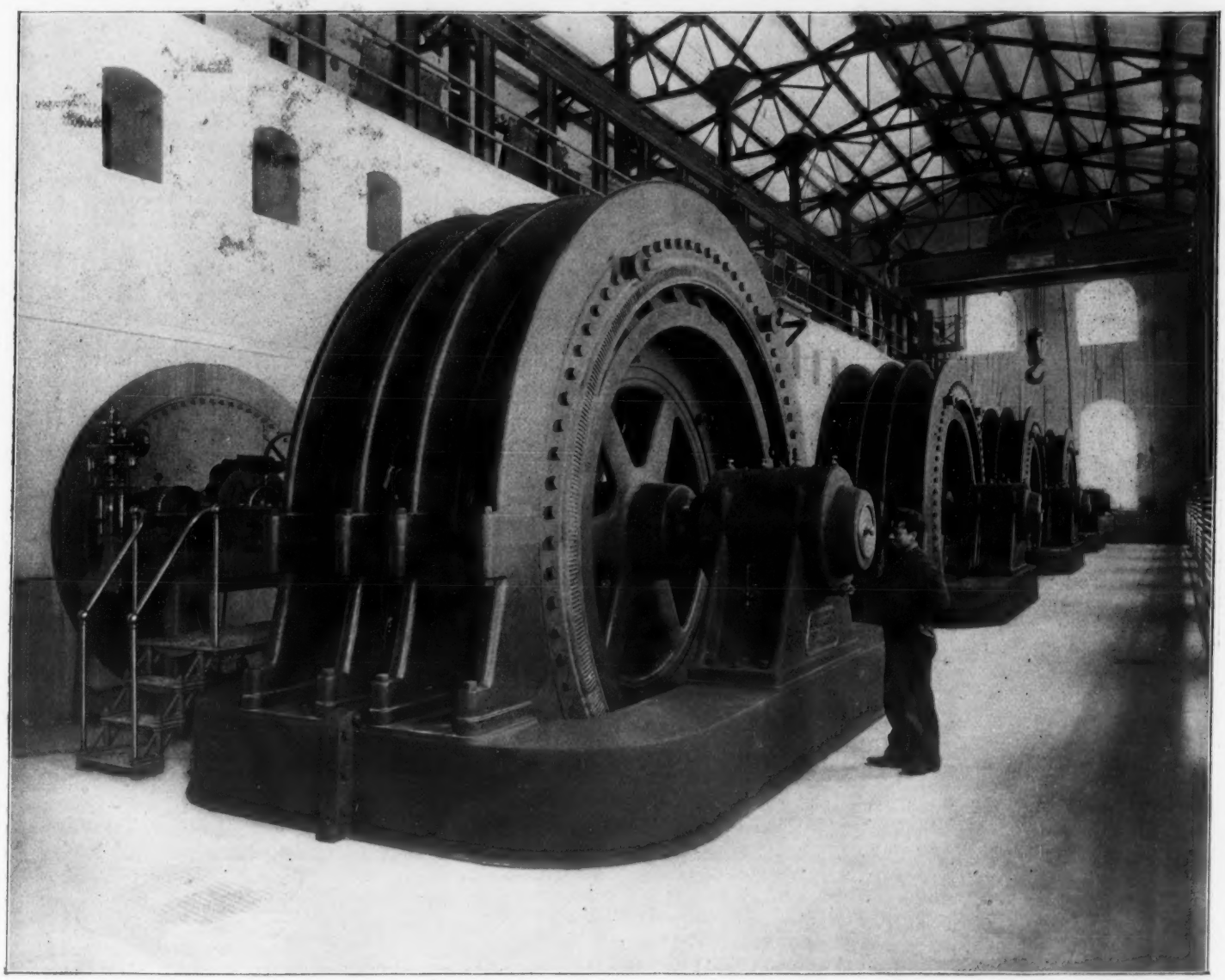


FIG. 1.—GENERATING PLANT, CHAMBLY, NEAR MONTREAL.

high-tension switches and even the instruments were specially designed for this plant.

GENERATORS.

The principal machines are, of course, the alternators, of which there are eight, four installed at present, each a 2000-kw two-phase inductor machine running at 153 r. p. m., and generating current at

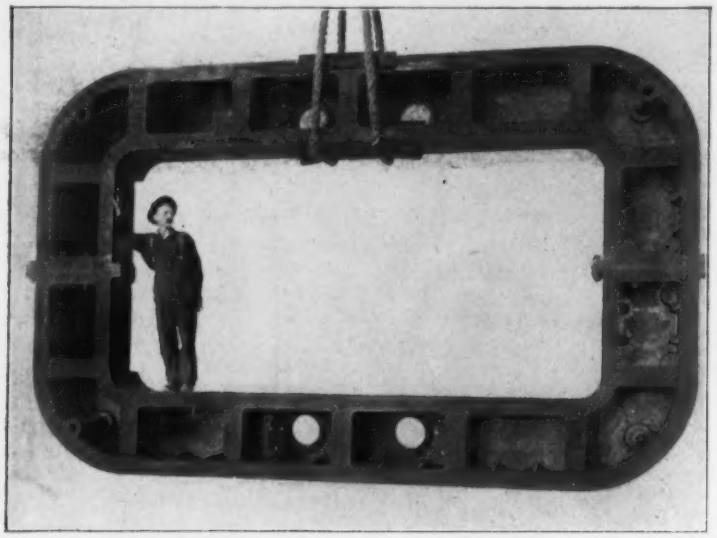


FIG. 2.—BASE OF GENERATOR.

12,000 volts directly at the machine at 8000 alternations per minute, or 66 cycles per second. Generating directly at the line voltage, 12,000, disposes of step-up transformers with the necessary switchboards and transformer house. This is perfectly practicable with the induction type of machine, as there are no moving wires, both armature and field coil remaining stationary, while the huge inductor, consisting wholly of iron, is the only revolving element. Hence, it only becomes necessary to secure sufficient insulation in order to obtain any desired voltage.

All joints in the armature coils are made with the greatest care in order to withstand such a high pressure. The joint after having been carefully soldered, is covered with several layers of pure rubber tape over which a composition of rubber and sulphur is placed, and covered all over with several layers of insulating tape. The joint is then soaked in boiling paraffin wax, which vulcanizes the rubber, thus producing a joint such that there is no break in the complete insulation of the wire. Such joints as these are made in

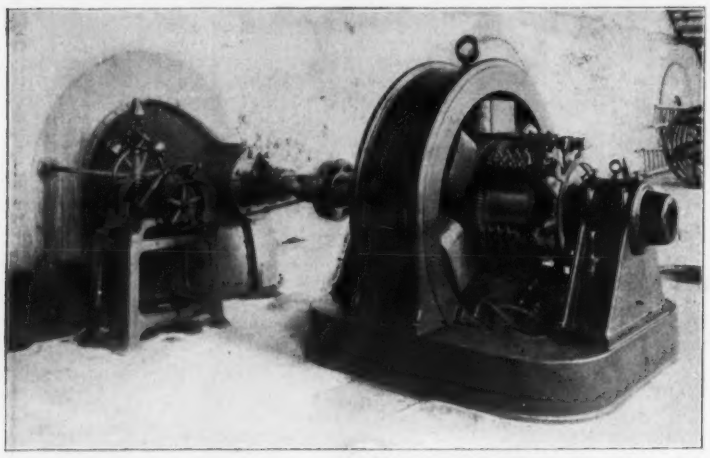


FIG. 4.—ONE OF THE EXCITER UNITS.

connecting the armature coils together, and for all switchboard work.

The base of one of these machines is a hollow rectangular piece of iron whose outside dimensions are 17 feet 2 inches long by 10 feet 11 inches wide and 25 inches thick, weighing no less than 100 tons. It is set on a concrete bed. Resting on this base is the armature, built up in two parts, an upper and a lower, bolted together in the middle. The lower half penetrates the base and dips into an excavation in the concrete, thus making the height of the machine appear less than it really is. This armature, which is of the well-known ribbed frame of the S. K. C. type, is 15 feet in diameter, 6 feet 6 inches wide. The coils are all machine wound, very carefully insulated and intersect each other, the inner curving around the outer so as to be in quadrature or at a phase angle of 90 degs.

The single field coil resting on the armature in a slot especially prepared for it, has a slightly smaller diameter than the armature, and is wound, not of wire, but of bare copper strip insulated with japan and insulating linen. The joints in this strip are butted together and soldered with a special solder, thus producing a joint no thicker than a copper strip, which possesses a greater tensile strength besides an equal conductivity.

The inductor, built of laminated iron, and weighing 30 tons, is the only revolving element in the whole construction, and is built up very solidly, the poles each being securely bolted to the spider.

The air gap between the inductor and armature is one-half inch. The field excitation, as is the case in all S. K. C. machines, is very small, being only three-fourths of 1 per cent. of the total output of the machine. The shaft to which the spider containing the inductor is attached is 12 inches in diameter, and is coupled directly to the turbines. The pillow blocks are bolted securely to the base and the bearings are of the self-oiling and spherical-seated type.

The governor regulating the gates of each wheel is the Geisler electromechanical governor, manufactured and installed by the Stilwell-Bierce & Smith-Vaile Company, of Dayton, Ohio, and is geared directly to the governor shaft.

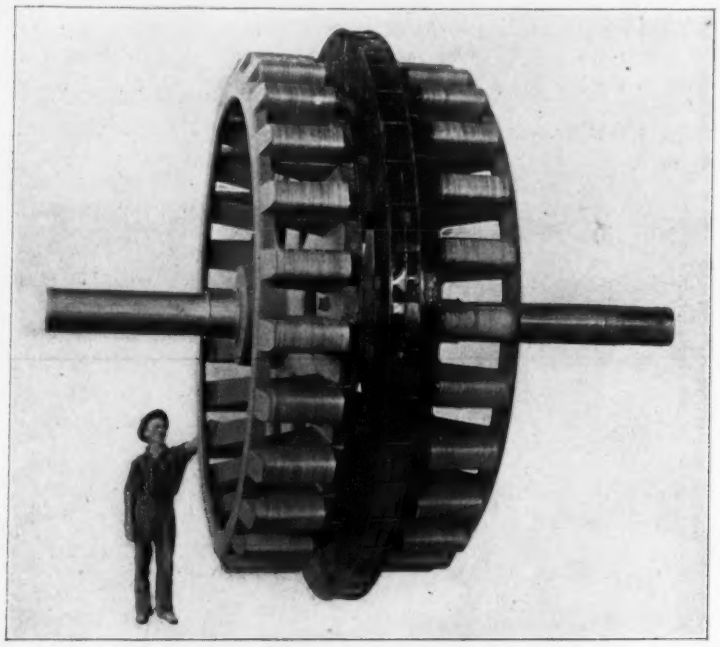


FIG. 3.—INDUCTOR AND FIELD COIL.

The two exciters, each of which is capable of fully exciting the complete installation, besides running the crane motor, have each six poles, a capacity of 140-kw, running at 266 r. p. m. and generating current at 75 volts pressure. They are of the large drum-armature type, with large commutator, and are well ventilated. A feature is that they are shunt-wound machines. Regulation is afforded by Snow mechanical governors, belted to the exciter shafts.

An electric crane, having a capacity of 40 tons, from the works of the Shaw Electric Crane Company, Muskegon, Mich., runs the entire length of the dynamo floor.

From the alternators and exciters the cables pass through ducts in the concrete floor to the cable tunnel, situated under the switchboard gallery. This cable tunnel has a vaulted roof and is of sufficient height and width to allow free passage to several people walking abreast. It is lighted and ventilated by casements in the concrete wall. These casements may be seen in the view of the dynamo room, directly below the switchboard gallery.

The cables, which are all lead-armored, from the works of the Washburn & Moen Company, Worcester, Mass., are placed on racks in the cable tunnel, and are passed through ducts in the solid concrete to reach their respective places on the switchboard. The exciter cables are connected four in multiple, each of 400,000 circular mils, the four having a capacity of 2000 amperes. The rubber insulation on all the cables is 5-32-inch thick and they are tested to 400,000 volts.

SWITCHBOARD GALLERY.

The switchboard gallery, situated, as it is, over the wheel pits, commands a view of the entire power house overlooking the dynamo floor.

The switchboard, only half of which is at present constructed, is built of white Vermont marble panels, tested to 20,000 volts, on a frame of hardwood. This frame is seasoned cherry, and for further insulation and protection from fire is well soaked in asbestos paint. This makes it practically fireproof, and besides offers the additional advantage of being absolutely free of danger from accidental contact at all times, unlike a steel frame.

There are two sets of busbars. These busbars have a 5-32-inch rubber insulation with a thick jute outer covering. This was used instead of a lead armored bus on account of there being no possibility of a static charge collecting, as would be liable in the latter case. As it stands at present, the main switchboard contains 9 panels, the first for the exciters, four for the generators and the remainder the line panels.

The exciter panel contains the two double-pole single-throw exciter switches and one double-pole double-throw switch for connecting the electric crane motor to either exciter; three ammeters, one for each exciter, and the other crane motor, the two exciters, voltmeters and rheostats.

The machine panels are exactly similar to each other, so that a

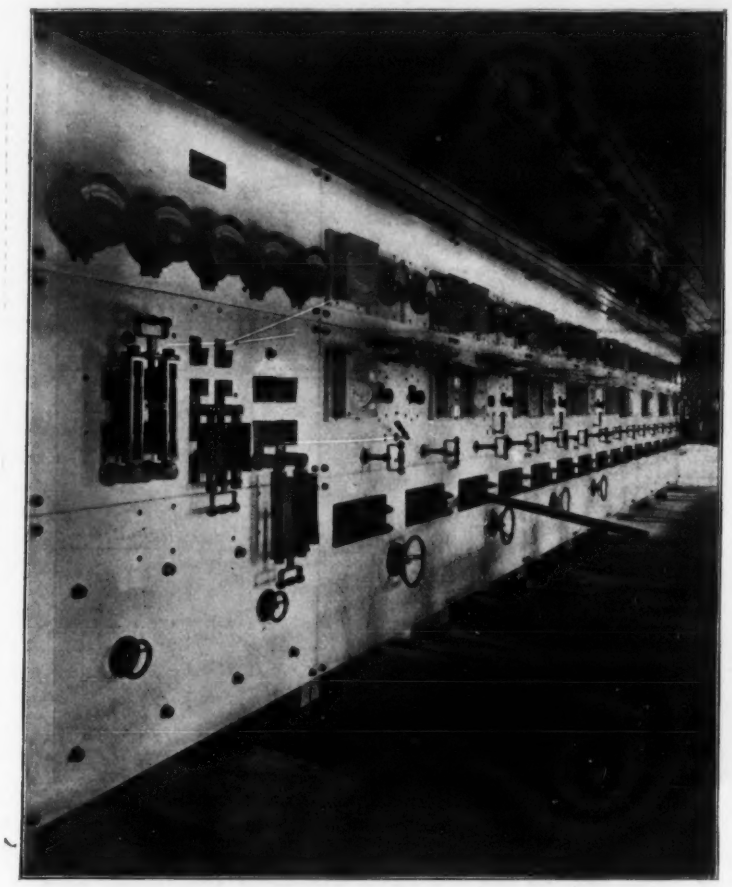


FIG. 6.—SPECIAL SWITCHBOARD FOR HANDLING 10,000-HP AT 12,500 VOLTS.

description of one applies to all. At the top of the board there are four instruments, two ammeters and voltmeters, the ammeters being placed outside, one set for each phase of the generator; below these are the voltmeter and ammeter for measuring the generator field excitation, while between them is the synchronizing apparatus, consisting of five lamps and a three-pole switch for each phase. The lamps are arranged three in the upper row, connected respectively to the upper busbars, the three-pole switch being similarly connected; and two synchronizing lamps in the lower row. Then comes the generator field switch, the two main 12,000-volt switches and, lastly, the field rheostats.

The apparatus on each line panel consists of two ammeters, one for each phase; a static ground detector connected in any circuit as desired, and the two pole-line switches.

The main switches used on the generator and line panels are a new departure and need an explanation. They are special high-tension switches for breaking a circuit of 12,000 volts and over, but are only necessary when such a high pressure is generated directly from the machines. As they appear on a switchboard there is only a small iron frame in which a long, wooden lever may be turned through a 120 deg. arc, and a small iron handle placed above. This latter is connected by means of a lever on the back of the switch-

FIG. 5.—THE CABLE TUNNEL.

board, to two valves, each placed in an air duct, into which air is pumped from a fan blower. These air ducts are two wooden boxes running the entire length of the switchboard, and are situated so that when the valve is open a jet of air impinges on the contacts of the high-tension switch, thus destroying the arc. The iron handle directly above the high-tension switch cannot be opened until the valve in the air duct is also opened, thus always insuring an air blast on the breaking contacts.

For the switch itself the moving lever on the face of the board is directly connected to a rocking lever which moves to and fro, a trolley containing the dead side of the switch. This trolley moves forward and engages with one set of contacts connected to the upper busbars, or backwards to the lower busbars, according as the lever is moved to the right or left of the centre. The contacts of the two sets of busbars are 9 feet apart, and though the "off" position of the trolley is midway between the two, a break of 6 feet may be produced, by moving the lever slightly past the centre. There are two of these switches for each generator and line panel. To prevent arcs from jumping from one switch to another, they are separated by marble barriers two feet high.

All the ammeters and voltmeters in use on alternating current are enveloped in a handsome ground glass case to protect the switch-

FIG. 7.—POLE LINE OVER RICHELIEU RIVER.

board attendant, should he persist in his habit of tapping the instruments, from receiving the shock he would get from an iron cased instrument, should there chance to be a leak.

For supplying the air ducts with air, two 48-inch Sturtevant fans

are used, each direct-connected to a two-phase 500-volt S. K. C. induction motor, either being capable of keeping up the supply required.

To reduce the line voltage to 500—that required by the induction motors for the fans—four single-phase Stanley air-cooled transformers are used, a special switchboard for these consisting of four white marble panels mounted on a hardwood frame being installed at one end of the switchboard gallery.

The high-tension switches are of the bayonet-stick type, each separated by heavy marble barriers. The low-tension switches are the ordinary S. K. C. slide type. D. & W. non-arcing enclosed fuses protect the transformers on both the primary and secondary sides.

For a local circuit, the two 60-kw single-phase Stanley air-cooled transformers are also installed. The switchboard for these is similar to the one just described, except that it consists of only two panels.

POLE LINE.

From the front of the power house the line wires, still lead-armored, pass through quarter-turn porcelain tubes to prevent rain from leaking into the power house, through wooden ducts to the terminal house, and thence to the pole line. There will be four four-wire two-phase transmission lines, on two separate pole lines, each 16.6 miles in length, although only two lines are as yet completed.

No fuses or circuit breakers are used in the line, as the generators, on account of the great inductance of their armatures, will carry a short circuit for a time without injury.

The pole lines are built very substantially, the poles being of white cedar, 45 feet long, 8 inches in diameter at the top, set 6 feet in the ground and spaced 90 feet apart. In places where it is necessary, they are embedded in concrete.

The transmission wires, four on each cross-arm, are No. 00 medium-drawn bare copper, 18 inches apart, securely fastened to triple-petticoat porcelain No. 1 Imperial insulators, tested to 40,000 volts. These are screwed to oak pins, which are in turn fastened to the cross-arm by a saddle bolt from below.

For protection against lightning, there are three barbed wires grounded at every pole, run the entire length, one on top of the pole, the other two at the outer ends of the upper cross-arm; all are mounted on glass insulators, these being used on account of the lesser liability of fracturing the barbed wire, and thus producing a short circuit, than when secured by ordinary steeples. Besides these are two banks of S. K. C. lightning arresters and choke coils at four places on the line where it passes underground, as well as at the power house. At such points there are eight gaps between each line and the ground, each gap being for 2000 volts.

From the power house the pole line crosses the Richelieu River below the dam, the poles being embedded in immense concrete piers, along the line of railway to the new Victoria Jubilee Bridge, over a mile long, spanning the St. Lawrence. Here it passes into two wooden boxes, each containing one line, situated outside the guard rail. Thence it again takes to the poles on the company's right of way to the Lachine Canal, which it crosses in 3¼-inch steel tubes, two wires each, placed 6 feet below the bottom of the canal, and thence to the substation. The line loss is about 10 per cent. at full load.

The line tests on June 24 proved perfectly satisfactory, not the slightest indication of a ground showing on the line, the pressure on which, as stated before, is 12,000 volts direct from the machines without any interposition of transformers.

SUBSTATION.

The substation, situated on Prince Street, in the premises occupied by the Royal Electric Company, is a brick structure, the floor of which is several feet below the surface for reasons to be developed later. This building has thoroughly waterproof foundations, even several feet above ground, on account of the tendency of the St. Lawrence to overflow its banks in the spring and produce a flood in the lower parts, though protected by dykes, as they are.

FIG. 8.—SUBSTATION IN MONTREAL.

The lead-armored cables enter from below, pass to a high-tension switchboard, the switches, air ducts, with their fan blowers and busbars, similar to those used in the power house previously described; thence to the transformers, the voltage being there reduced to 2300, the city pressure; thence back to the switchboard to what is called a transfer board, where the transformers may be coupled in any combination desired without any possible danger or short-circuiting the line. The method of doing this is to have the plugs of one polarity slotted and keyed so as to connect with jacks of the same polarity. The needed instruments, ammeters, voltmeters and ground detectors, all glass encased, are also situated on this switchboard.

There are twenty-four 200-kw single-phase Stanley transformers immersed in mineral oil and water-cooled, in three rows of eight each. Each transformer is enclosed in a rectangular cast-iron tank, in which a free circulation is obtained through coils of pipe, the sup-

ply being obtained from the Lachine Canal, not far distant. The Royal Electric Company has a perpetual grant of water from this canal, obtained from the government, and for this reason the substation was excavated deep, so that water would flow from the substation to the transformers by gravity. This substation is only one-third of the total output of the water plant, but readily admits of enlargement by removing some of the boilers used at present.

Each transformer is given a clear space free from obstruction, while situated directly in front is its switchboard, consisting of high and low-tension sides, the switches on the former being of the bayonet-stick type mounted on a white marble panel, and each separated by a heavy marble barrier to prevent arcs from jumping across; the switches on the low-tension side are of the S. K. C. slide type. Connected in the secondary of each transformer is a glass case ammeter indicating the load that each is carrying. The framework of these switchboards is of white oak well soaked in asbestos paint, and then erected and allowed to dry for upwards of a year. It was then given two coats of asbestos paint, after which it is practically fireproof. Each transformer is protected by D. & W. non-arcing enclosed fuses on both primary and secondary sides.

Power and light are supplied from the same circuits, the slight regulation being performed by hand at the distributing board, the machines themselves having an inherent regulation of 10 per cent. between no load and full load.

As each phase is independent in the two-phase system, no method is needed to balance the loads on each phase, except that in order to obtain the full capacity of the machine each phase must be fully loaded.

Death by Electricity.

By R. H. CUNNINGHAM, M. D.

As this subject is of such vital importance to all practical electricians, possibly many of your readers may be interested to read a brief description in non-medical language of how every-day electric currents induce death in the lower animals. Exactly how a man is killed by such currents is for the present unfortunately not definitely answerable, but as I have pointed out in a previous paper on this subject in the New York *Medical Journal* of Oct. 21 and Oct. 28, clinical evidence as well as the presumptive evidence from animal experimentation makes it quite probable that such currents kill men in essentially the same way that they kill a monkey or a dog. Thus my positive assertions in the above-mentioned paper, as well as in this article, relate to those phenomena that are exhibited by the various lower animals when they are subjected to the powerful electric currents of commerce.

For many years the question whether death from electricity results from that but slightly understood condition which the medical text-books describe as "shock," or whether it results from some indiscoverable molecular alteration of the tissues of certain organs necessary to life, or whether it is produced by the abnormal prolongation of some physiological effect of the current, has been the subject of much controversy among numerous scientists, and every kind of good, bad, or indifferent evidence has been brought forward to elucidate the problem. When I first investigated this subject five years ago by making a few experiments on dogs with arc light and other varieties of continuous currents at a thousand or more volts pressure, I passed them for various periods of time across the chest, through the brain, and from the brain to the thighs or to the belly, but from the lack of proper physiological registration apparatus I was able to determine definitely no more than had been determined definitely by Dr. Tatum in 1890, namely, that the chief lethal effect of currents, both continuous and alternating, seemed to be upon the heart.

What this cardiac effect was, I recognized immediately, but owing to the fact that Dr. Porter's simple method of recovering the excised heart of the dog was not known to physiologists at that time, no way of definitely proving what I considered to be a fact, occurred to me. Therefore, to solve definitely the question of how electricity kills an animal I resumed last winter my previous experiments of five years ago, and followed my former plan of applying the currents in the three ways described above. In this instance, however, the upper surface of the brain and the upper portion of the spinal cord were exposed by removing the protective bony and soft parts, so that the electrodes could be applied directly to those parts. The e. m. f. of the continuous currents employed was from 112 to 124 volts. By making good broad contacts as much as 3.8 amperes could be passed through many of the animals. The duration of the shock varied from one-tenth second to one or more minutes. In every experiment the proper registration apparatus was employed to record graphically the most important phenomena manifested by the experimental animal.

Briefly summed up, my results with these currents were essentially the same as my former results obtained with currents of higher tension which permitted a greater number of amperes to be passed through the animal. These results were as follows:

When the chest was traversed by a sufficient number of amperes, or fraction of an ampere, for a sufficient length of time, the most important effect produced was the immediate cessation of the co-ordinate beat of the heart. Consequently the circulation of the blood throughout the body ceased, and the various delicate nerve cells of the central nervous system died rapidly from the lack of indispensable blood. The action of the current upon the heart is clearly a physiological one, and the state produced in it is what physiologists term fibrillation. Roughly speaking, in this condition, the rhythmical synchronism of the contractions of the little muscle bundles of which the heart is composed, is profoundly disturbed, and the contractions of the bundles fall out of phase. Thus the heart fails as a blood pump and death quickly results unless the circulation is restored.

As the hearts of the higher mammalia practically never emerge spontaneously and permanently from this condition, it is evident that unless something is done to restore the circulation very quickly death results inevitably in a very short time. But it has been known for many years to physiologists that the lower the order of the animal, the more readily does the heart recover spontaneously and permanently from fibrillation, so that when guinea-pigs, rats, mice, turtles, frogs and fish are subjected to strong currents the permanency of the cardiac effects is less pronounced.

Owing to the small size of such animals, it is practically impossible to prevent a large part of the current from traversing the nervous system so that the chief physiological effect of the current is, as would be expected, upon their nervous systems, and is identical with that produced by passing the current only through the brain and upper part of the spinal marrow of a dog in such a fashion as not to include the heart in the circuit. When passed in this way through the brain comparatively weak currents (1 to 2 amps.) usually produce a more or less pronounced stoppage of the rythmical respiratory movements during the time that the current is passing. When the circuit is opened, generally this so-called inhibitory effect passes off in a moment, and the breathing commences again. With very strong currents (6 to 12 amps.) usually one or more general convulsions follow the powerful stimulation of the cortex of the brain, and the respiratory inhibition is more pronounced and lasts for a longer time after the flow of the current has stopped. Consequently, if the respiratory inhibition persists long enough death results from asphyxia. If the degree of asphyxia is not permitted to become too profound such animals can be restored by means of artificial respiration.

When the circuit includes the brain and the heart, one would expect very naturally that the effect would be a combined one, and such is the case. The heart is thrown into fibrillation, the blood supply to the brain stops, and the effects due to the excessive stimulation of the nervous system either by the current or by the complete anaemia, if the shock is brief, become prominent and finally cease.

To resuscitate an animal under such circumstances it is quite evident that the co-ordinate heart beat and the circulation must be re-established before that most perishable part of the body, the central nervous system, becomes too profoundly depressed by the prolonged absence of the necessary blood. Unfortunately the vitality of the more important nerve centers does not withstand such a degree of anaemia usually for more than a few minutes, so that an attempt at re-establishing the circulation must be extremely prompt in order to be successful. Now, as I have pointed out elsewhere, it is comparatively easy to re-establish the co-ordinate heart beat in the fibrillating dog's heart after its removal from the body by injecting defibrinated dog's blood through the nutrient blood vessels of the heart; but to accomplish the same result with the heart intact in the body and at the same time cause enough blood to circulate through the nervous system so that it will not die, is a much more difficult feat to accomplish even in a laboratory with all the necessary apparatus at hand. To accomplish the above result, I estab-

lished an artificial circulation through the electrocuted dog by injecting blood with a specially devised apparatus, which is fully described and depicted in a previous article, into a large artery in the neck, and at the same time withdrawing blood from the right side of the heart after passing a tube down into it through one of the large neck veins, in order to prevent over-distension of the heart and veins.

To avoid the difficulty and the necessity of keeping up the artificial circulation for the considerable time that often elapses before the fibrillating heart recovers, I applied several varieties of powerful, momentary electrical stimuli or shocks to the exposed heart, and found that when the properly adjusted brief discharge of a condenser, for instance, that from the outer coating of two one-quart leyden jars arranged in series and charged on their inner coats by an 8-inch induction coil, was sent momentarily through the fibrillating heart, it gave a co-ordinate beat, which was maintained, provided defibrinated blood continued to be injected through the arteries of the heart. To produce the same result upon the fibrillating heart within the body, much larger condensers were found to be necessary. In other words, that variety of powerful physiological stimulus appears, so to speak, to throw the contractions of fibrillating muscle bundles into phase for a moment, and once in phase the muscle bundles remain so, provided the necessary blood continues to flow through the heart vessels, a condition that is maintained automatically with the return of the co-ordinate heart beat.

Although the above facts were discovered by me independently during the early part of last winter, as many who witnessed my experiments can testify, their publication was delayed for certain reasons mentioned in my article in the New York *Medical Journal*. But others beside myself were evidently studying this subject in a partly similar manner, and to Messrs. Prevost and Battelli, of Geneva, must be given the credit for first publishing the statement that continuous and certain kinds of alternating currents kill some varieties of animals by producing fibrillation of the heart, while others die from respiratory inhibition. In their papers another very interesting statement is made also, namely, that if a momentary shock from a 4500-volt transformer (amperes not mentioned) was given to a dog, within a few seconds—that is, as I judge from their tracing, before the circulation has ceased completely and the blood pressure fallen to zero—after it had received a shock of brief duration from a low voltage current of a strength usually sufficient to produce permanent fibrillation of the heart, the heart immediately resumed its co-ordinate beats in response to the powerful momentary stimulus. If many seconds elapsed before the application of the powerful stimulus, the co-ordinate heart beats failed to reappear, a result, due in my opinion, very probably to the fact that the circulation had become totally extinguished. As the foregoing procedure in conjunction with my method of creating an artificial circulation through the body is evidently easier of application than my method of stimulating the fibrillating heart with a sudden condenser discharge, I am engaged at the present time in investigating whether or not it is as efficient.*

It is clear from the preceding statements that it is possible for the lower animals to be resuscitated by the above mentioned means, after they are electrocuted by certain kinds of electric currents, provided the application of the current is not too prolonged, but such a fact need not lead one to conclude that when an electrocuted criminal reaches the autopsy table, if a similar method of resuscitation is applied to him, he could be resuscitated. At the official electrocutions a strong current, about eight amperes, followed by a current of two or three amperes is applied for a minute or more; a medical examination is made, and the individual pronounced dead; the body is removed from the chair, and by the time that it is ready for the pathologists so many minutes have elapsed that it is extremely probable that the individual's nervous system has become totally incapable of revival, owing to the prolonged arterial anaemia.

*Brief shocks of one or two seconds' duration from alternating currents of high voltage (4500 volts and above), do not throw the fibrillation, according to Prevost and Battelli, but kill by causing a more or less permanent inhibition of the respiration. Low voltage alternating currents kill in the manner described above. This curious and interesting fact I have lately been able to verify to a certain extent during several recent but unsuccessful attempts to quickly recover the fibrillating heart by injecting it with blood and applying brief shocks from a high voltage transformer. For instance: 6 amp., at about 12,000 volts, was passed across the chest of a dog for five seconds without producing more than a momentary stoppage of the heart, but no fibrillation occurred. When the head was included in the circuit a temporary cessation of the breathing took place.

Electricians and others receiving shocks from such high voltage alternating currents should by all means have one of the methods of artificial respiration performed upon them the moment the breathing begins to appear shallow.

As I have already remarked recently in this journal, animals do not appear to be killed instantaneously by the above varieties of currents, although death supervenes with great rapidity, and the same statement applies very probably to men if clinical data are to be relied upon. Nor does there seem to be an instantaneous loss of consciousness; that is, consciousness is not lost synchronously with the beginning of the shock. It is true, this period of consciousness may be extremely brief, but this brief period seems to be invariably ample for the individual to perceive that he is in contact with some kind of an electric current, although this sensation seems to be comparatively painless, according to the statements of those who have received severe but not fatal shocks.

As regards the minimum intensity of current necessary to produce cardiac fibrillation in man, and thus cause death, I can give no reliable data, although judging from my experimental experiences, as well as from the clinical reports of fatalities from low-tension illuminating currents, it is very probable that the physiological susceptibility to the current varies in different individuals and also that an individual is more susceptible at certain times than at others. In many dogs .2 ampere applied for a quarter of a second across the chest wall prove just as lethal as a current of 3 amperes applied for a minute. Since the 110-volt illuminating current seems capable of electrocuting certain individuals, my concluding advice to everyone is to avoid coming in contact with the bare mains conveying such currents, for though one may often touch live 110-volt mains with impunity at certain times, it is possible that he may do it at a time when his susceptibility to the current is heightened, and thus receive a shock that may readily produce fatal physiological effects.

The Lachine Rapids Power Plant.

Extensive improvements are being made upon the works of the Lachine Rapids Hydraulic, Land & Power Company, of Montreal, at Lachine Rapids. The company's power dam, which was originally about 4000 feet long, is now being enlarged and precautions taken to prevent injury from ice. When completed it will be over 5000 feet long and two feet higher. The boom, also, has been put much farther up the river. The result of these improvements is very important; for not only has the current been changed in direction, but the "head" of water has been made much greater. One of the difficulties which had formerly to be contended with was the ice, which was driven into the dam. On account of the alterations of the direction of the current and the increased height of the dam the possibility of ice jamming in the dam is reduced to a minimum; and it will, owing to the new current, flow past the dam altogether. A building 1000 feet long has been constructed for the plant and machinery, and the company is able to supply a very great amount of light and power. As it would have been a useless and unwarrantable outlay to equip a maximum plant at the start, only such machinery as would likely be required for the first year of the company's operations was purchased but arrangements were made so that additions could be carried out as needed. There are 72 turbines in all, of which 24 are now in use. Each set of twenty-four turbines, connected with the main shafts, supplies energy for one generator house, where the electric current is generated. In the generator house there are four large dynamos, run by the turbines. To these generators are connected indicators which trace curves showing the service performed for the whole day. The electric current is conveyed to the power house on McCord street, Montreal, from which place distribution throughout the city is made. One thing of great practical importance is the means adopted to prevent lights from going out or circuits from being broken. It frequently happens that a wire falls across two of the company's wires, forming a short circuit, and causing the fuses at the terminals to be blown out. This contingency is provided against by a double system of connections, so that if one system becomes temporarily useless, it takes only about five seconds to switch on to the other.

The original idea of this company was to construct the dam and buildings and then solicit consumers to put in the plant and carry on the work, for which they would be paid by the company. But when some time had passed and no consumers were in sight, the company took up the work, and found, upon investigation, that it would do better to put in the necessary plant and carry on the whole work itself. To accomplish this object, the capital stock of the company was increased to $2,000,000; and in September, 1897, about 15 months after the work of construction of electric power was

commenced, the water was first let in on the turbines, and the generation of electric power was started. Since that day the work has rapidly advanced, and now there is a generating capacity amounting to something over 5000-hp. The company now controls 80 miles of electric lines, and is continually adding to them. This plant was fully described and illustrated in these columns Aug. 5, 1899.

Electrical Plant of Ohio State University.

BY BURCHAM HARDING.

THE grounds of the Ohio State University, which holds a prominent place among the public institutions of learning in this country and is situated at Columbus, O., consist of 330 acres. The eastern portion is occupied by the principal university buildings, eleven in number, and by the campus, athletic, and drill grounds, and by a few acres of primitive forest. The University is divided into six colleges, one of which is the Engineering College, which provides educational facilities and technical training for each branch of the profession, by the aid of fifty-seven professors and assistants.

The course in Electrical Engineering is designed to give such training as shall enable the graduate to successfully take up practical work in those branches of Mechanical Engineering in which electricity plays the principal part. In general, the training needed for this purpose is the same as that of the mechanical engineer, except that the student need have only a general familiarity with other methods of power generation and utilization, and must, of course, make a very thorough study of the whole subject of electricity, from the point of view of the physicist, as well as that of the mechanic.

Consequently the first two years of the two courses are alike, except that the mechanical training in shopwork in the one is partially replaced by more extended work in applied physics in the other.

A considerable part of the third year is occupied by a thorough training in elementary electrical engineering measurements, such as currents, voltage, capacity, inductance, magnetic flux, etc. The third year also includes training in mechanics, mechanism, machine design and mechanical laboratory. Work in the drawing room and shops continues during this year.

In the fourth year, with the exception of five hours a week through the year given to steam engineering, the time is devoted to the study of dynamo machinery and the other apparatus of applied electricity, with its installation, testing, operation, etc. This is done by co-ordinate work in the class-room, laboratory and drawing-room. The end which is kept most in view is the training of the student to think for himself, and to solve for himself the problems which form so large a part of the work of the practical engineer.

The electrical engineering department has excellent facilities for practical experimental work with dynamo machinery and other electrical apparatus. The elementary electrical testing is provided for in the physical department, which permits this department to devote its energies to the study of the engineering apparatus proper. The dynamo equipment consists of twenty-five machines of various makes and sizes from 40-hp down, aggregating over 240-hp. These include 110 and 500-volt direct and alternating current generators, polyphase motors, arc and incandescent lighting generators, railway and stationary motors, a rotary converter specially designed for experimental work, and a unipolar dynamo. There is also a number of transformers, arc lamps of different styles, measuring instruments, and telephone apparatus. Power for running the dynamo laboratory is supplied by three induction motors taking current from the University power plant. There is also a small but well selected and growing collection of photographs, blue prints and material illustrative of electrical manufacture. The library of the department is kept in the building and is especially valuable on account of the completeness of its sets of periodicals and transactions.

The University electric plant was provided by the Westinghouse Electric & Manufacturing Company. The power station is one of the most modern and complete systems to be found for supplying heat and power from a central station, to a number of spacious and widely distributed buildings. The relative position of the buildings is seen in Fig. 3, which is a plan of the grounds of the Ohio State University from surveys made by the students in typographic surveying. There are ten buildings in the group, having a total heating surface of 41,000 square feet.

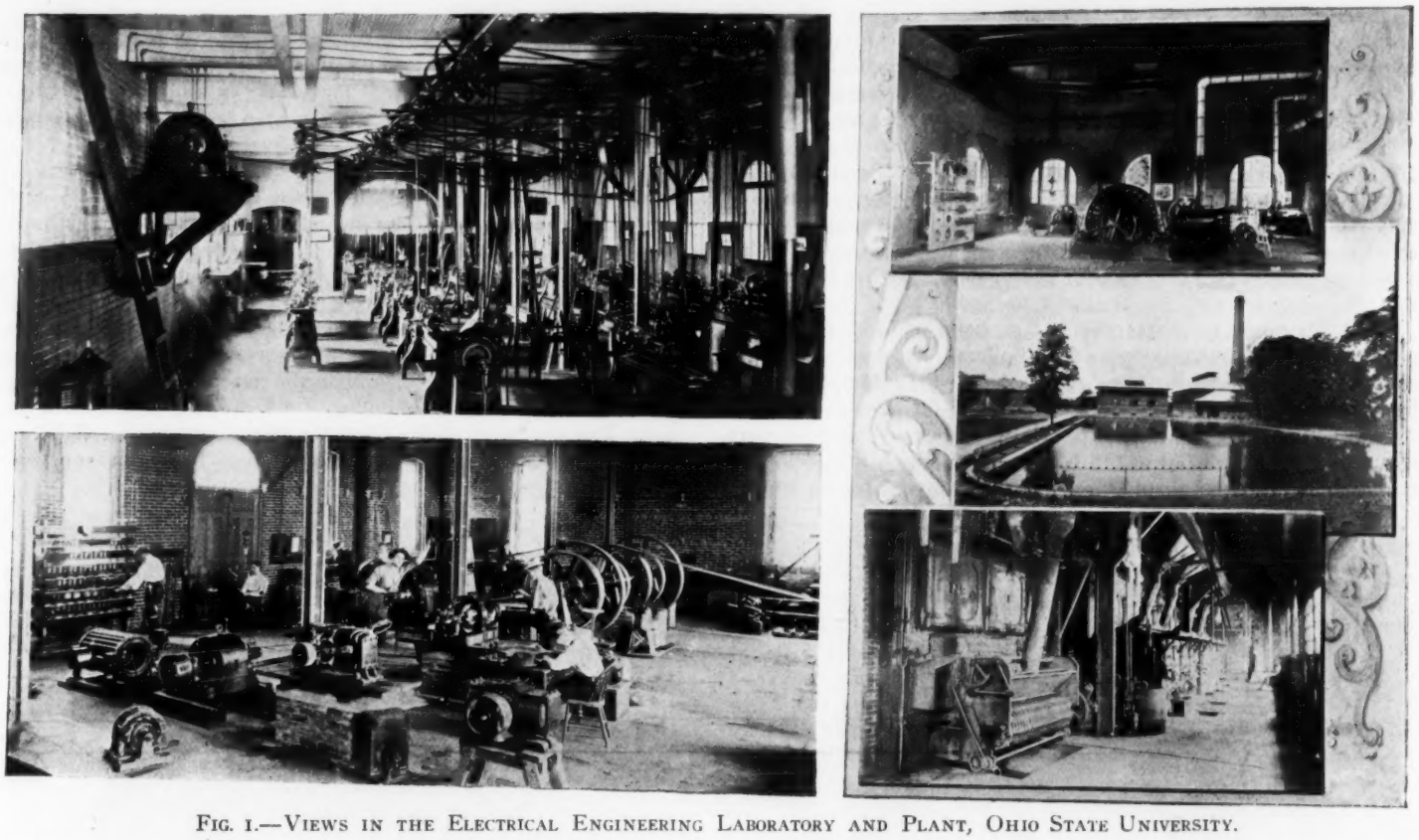


FIG. 1.—VIEWS IN THE ELECTRICAL ENGINEERING LABORATORY AND PLANT, OHIO STATE UNIVERSITY.

Heat is conveyed from the power station to the different buildings through a tunnel by a 10-inch steam pipe, having pressure regulators, reducing the pressure from 100 to 30 pounds. The size of the steam pipe is varied to amply supply each building according to its size. Fig. 2 shows a section of the tunnel, with steam, water and gas pipes, light and power conductors. The steam pipe is supported along the side of the brick tunnel, which is nearly six feet square, and has a total length of 4,100 feet, the longest distance to any single building being 2,500 feet. Beneath the steam pipe is a general return pipe, in which the water of condensation gravitates to the hot well in the boiler house, as the grade is about 1 in 900.

The wires for the light and power currents are also supported along one side of the tunnel, those for the high tension current being lead encased. To Mr. W. C. McCracken, the chief engineer for the Ohio State University plant, belongs the credit of engineering this entire system. The underground tunnel has been highly commended for conveying heat to disconnected buildings. Underground pipes for carrying steam are far from convenient, for when occasion arises for examining the line of piping or making any repairs or alterations, the difficulties are obvious and serious. This

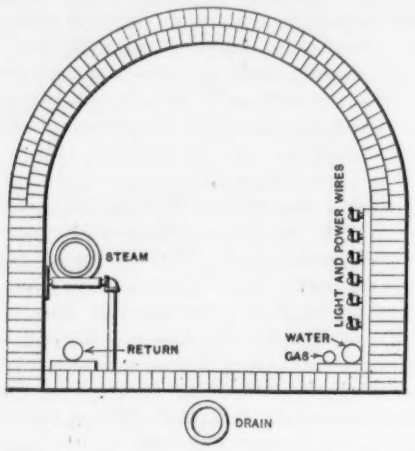


FIG. 2.—SECTION OF TUNNEL.

is particularly true in case of a leak, which may not be found without going to a great deal of unnecessary trouble and expense.

The rather complex and difficult heating and power system of the Ohio State University has operated in a most successful and satisfactory manner at all times and under all atmospheric and other conditions. Ample power and adequate warmth have been provided, with a minimum of care and supervision, and with economy in consumption of fuel. The tunnel construction renders it easy to make any changes that may from time to time suggest themselves, or to make repairs when, in the lapse of years, such may become necessary.

The boiler house measures 38x100 feet, being equipped with five Babcock & Wilcox 150-hp water-tube boilers, furnished with chain grates and mechanical stokers. At one end of the boiler-house is the coal storage, and at the opposite end the pit for the hot well, from which also runs the tunnel. Coal is carried by conveyors placed above and in front of the boilers, from which it is delivered by chutes to the furnaces. The ashes are removed by an endless screw conveyor, and then elevated to bins from which the contents will readily gravitate through chutes into wagons placed outside the boiler-house.

Water for condensing purposes is taken from the end of the reservoir farthest from the station, and discharged into the other end through a five-inch pipe. This reservoir is designed for fire purposes, as well as for condensing, being 90x200 feet and five feet

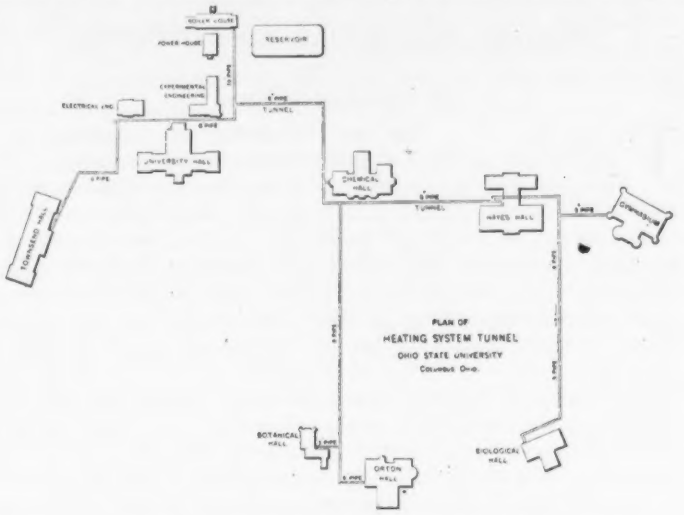


FIG. 3.—PLAN OF UNIVERSITY BUILDINGS.

deep, and when filled contains 500,000 gallons. It is interesting to note that during the coldest weather of last winter no part of the reservoir was frozen over. The water is pumped by a pneumatic system from a well beside a river 1,700 feet from the reservoir, and 40 feet below its level.

Near the boiler-house is the power plant, the building measuring 40x60 feet. The power generating plant consists of a 70-hp compound engine, belted to a 60-kw two-phase Westinghouse alternator, and a 200-hp compound engine, direct-connected to a 125-kw two-phase generator; both generators provide current at 1,100 volts to the main feeders. The generating plant occupies the main floor, together with a complete marble switchboard, with ammeters, voltmeters, wattmaters, static ground detectors, etc. A ten-ton traveling crane is available for handling the machinery in this room. Nearly all the University buildings are heated by steam from this plant. The total cost of the plant for generating power, light and heat, and for transmission and distribution, has been somewhat over $100,000.

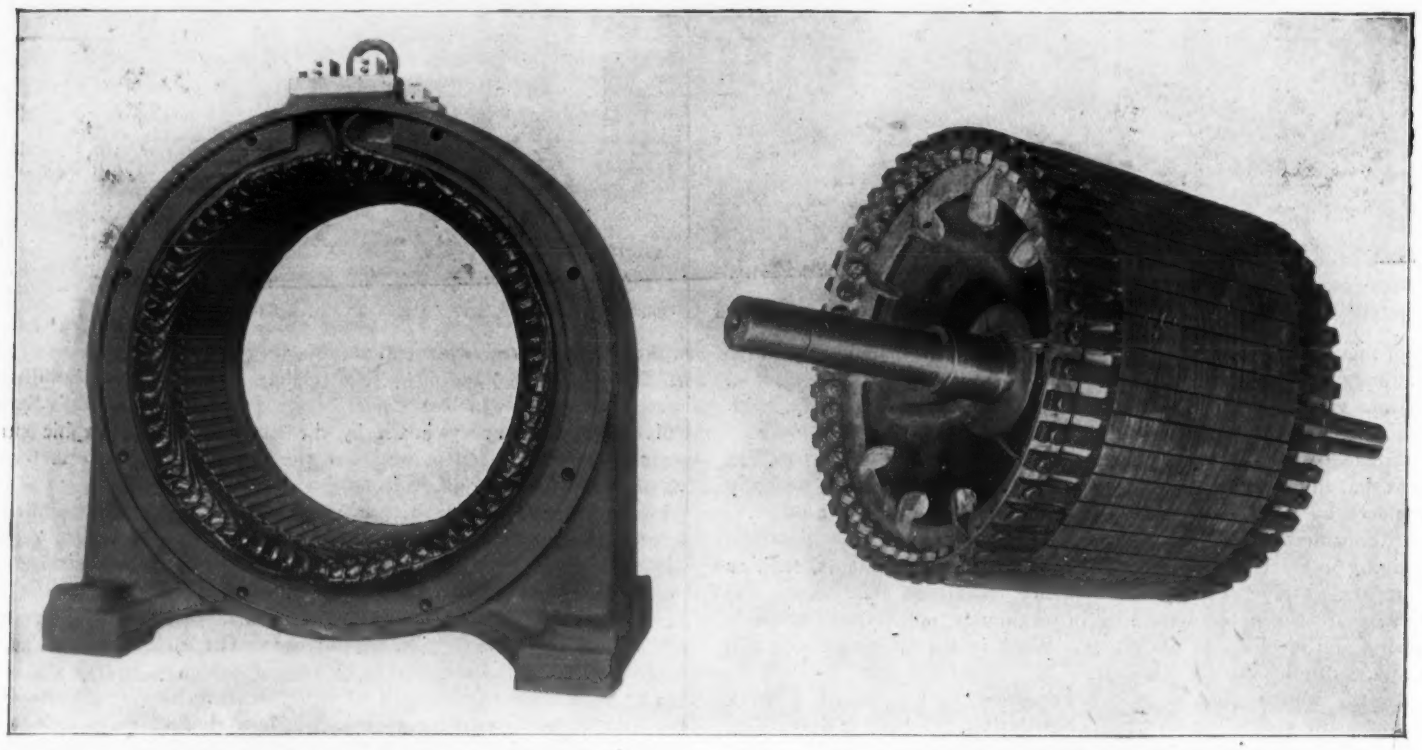


FIG. 4.—FIELD OF MOTOR.

FIG. 5.—ARMATURE.

The 500-volt direct-current system, installed in 1892, has been entirely discarded, and the two-phase alternating current system adopted throughout.

Seventeen Westinghouse type "C" induction motors are performing various kinds of useful work. Two 30-hp motors drive the shafting in the machine shop and in the electrical laboratory. A 20-hp motor drives the heating fan in Townshend Hall. Three 15-hp motors operate clay-working machinery, and heating, exhaust and blowing fans. A 12-hp motor provides power for a passenger elevator. A 10-hp motor works a feed cutter and threshing machine. Smaller motors, from 2 to 7½-hp provide power for fans and for machinery in the electrical laboratory.

The Westinghouse type "C" motor is notable on account of its absolute simplicity of mechanism and operation. It consists of a stationary part or field, shown in Fig. 4, within which revolves the rotating element or armature, shown in Fig. 5. The field is directly magnetized by current supplied from electric circuits, which induce low potential currents in the armature. The windings of the field are so arranged that when supplied with currents a rotating magnetic field is produced which acts upon the winding of the armature and induces currents therein. The rotating currents of the field acting upon the currents of the armature cause the latter to revolve, and communicates motion to the shaft upon which the armature is fixed.

Mechanically this motor is of the greatest simplicity, having only a stationary field connected to the main currents, and a revolving armature, with no electrical contacts or adjustments, but which starts into action as soon as current is turned on to the field. The only parts that can wear are the shaft and journal boxes, but the friction in these is so slight that a supply of oil once in three months suffices. The conductors of the armature are purposely short circuited, which obviates injury to the windings. The construction is practically indestructible from heating or mechanical injury in operation. These motors may be used with perfect safety in powder mills, grain elevators, woolen mills, or in any place exposed to explosive or inflammable gases, as they have no commutators, brushes or moving contacts from which spearks can be thrown off.

There are six transformers of 25kw each connected in parallel, placed in the basement of the power station, changing 1100 volts to 440 volts for power purposes. The lighting transformers of 114-kw, changing 1100 volts to 110 volts, are placed in the basement of several of the buildings to be lighted, or in the tunnel close to the buildings. On the lighting circuits are 2200 incandescent and arc lights.

The consumption of coal for one year amounted to 5000 tons of Hocking Valley pea coal, whose average calorific value is 11,000 B. T. U. per pound, and gives about 14 per cent. of ashes. This fuel provides heat, light and power for the ten large buildings, widely separated from each other.

Students taking the electrical course find the University power plant of great value as illustrative of a model installation. Columbus and neighboring towns have several electrical plants which can be visited for the purpose of study, and afford valuable assistance to the mechanical and practical side of electricity.

A Commercial Cable to Cuba.

One of the first measures which, it is said, will receive prompt and favorable consideration by the new Senate committee on our relations with Cuba, is the bill introduced by Senator Stewart, authorizing the Commercial Cable Company to lay a cable between the United States and Cuba. No reference is made in the resolution to the existing Western Union cable monopoly. The resolution introduced by Senator Stewart provides: "That the Secretary of War be, and he is hereby authorized and directed to grant a permit to the Commercial Cable Company of Cuba to lay and operate a submarine cable from the coast of the United States to the Island of Cuba on the terms and conditions usual in such cases." The resolution has been referred to the Committee on Relations with Cuba, of which Senator Platt, of Connecticut, is chairman. Many memorials and resolutions from chambers of commerce and boards of trade in various parts of the country favoring the proposed legislation have been received in the Senate, and are now with the Committee on Foreign Relations.

Storage Batteries and Isolated Plants.

By Alton D. Adams.

The Electrician, of London, dated Oct. 20, 1899, contains an editorial from which the following is a quotation: "If, taking account of interest, depreciation and cost of attendance on a storage battery, it is economical to level a consumer's load by this means, the same would apply to the station itself." The editorial then goes on to state "that it does not pay a public supply station to include in its equipment a storage battery large enough to level the highest peaks of the load curve." This matter was written in criticism of an article by the present writer in *Cassier's Magazine* for October, 1899.

The article in question was intended to show that with very low rates for central-station service, at certain hours of the day, when the public demand is least, it may be more to the advantage of a consumer to put in a storage battery and charge with the cheap central-station supply, than to put in engines, boilers and dynamos for an isolated plant. One conclusion reached was that where exhaust steam cannot be used for heating, the low rates made by some stations for supply, taken at certain times of day, make the battery more desirable for a consumer than a complete generating equipment.

Whatever may be the exact meaning of the words quoted from the above-named editorial, the hard fact remains that a condition and not a theory engages our attention. The average charge for electric energy from central-station supply is a certain amount in any particular case, being about 10.6 cents per kw-hour for the one cited. The cost to large consumers of electric energy from their isolated plants commonly varies from 3 to 6 cents per kw-hour, much depending on the amount of exhaust steam that can be used and on the labor required by the isolated plant beyond what would otherwise be necessary. Public supply stations, during some hours of the day and night, when the demands on them are least, are glad to sell electric energy at a fraction of their regular average charge, a rate as low as 3 cents per kw-hour having been made, by the station cited in above article, for service at times of the lightest loads.

In some private establishments that would otherwise use an isolated generating equipment, it can be shown that the storage battery, when charged at the lowest public rates, will give the cheapest service, because exhaust steam cannot be used to advantage, and much of the help necessary for the generating plant would not otherwise be wanted. The management of a private concern under these circumstances will not stop to ask whether it would pay the public station to put in batteries there and charge him a rate that he will not pay for energy, but will install the batteries instead of the isolated generating equipment, and take advantage of the low rate during hours of small public demand.

For example, take the case of an office building, where conditions are such that the cost of energy generated by an isolated plant of boilers, engines and dynamos is 5 cents per kw-hour, and let the demand for this energy occur in large part between the hours of four and ten p. m., as is commonly the case, when the public supply is most heavily loaded. The central station will supply electric energy to this building during the times it is wanted at, say, 10 cents per kw-hour, because the capacity of the station equipment in boilers, engines and dynamos or in batteries must be increased to correspond with the highest kilowatt output during the hours of maximum load. Leaving the batteries out of the question for the moment, the owners of the building just considered will probably elect, as thousands of others have done, to install an isolated plant and generate the required electric energy at a cost of 5 cents per kw-hour, rather than to pay the public supply rate of 10 cents per kw-hour.

The argument of the above editorial, if extended to the isolated plant, would seem to be, that because the central station cannot afford to put in the additional boilers, engines and dynamos to supply this building at the time of maximum load, for less than its regular charge of 10 cents per kw-hour; therefore, the building owners can hope to gain nothing over public supply rates at 10 cents, even though it is certain that the total cost of energy from the isolated plant will only be 5 cents per kw-hour.

That this argument is not appreciated by large users of electric energy, is shown by the thousands of large isolated plants that dot the areas of public central-station service. Assume now, as is actually the case in some instances, that the public supply rate during certain hours of the day and night is only 3 cents per kw-hour for energy taken exclusively at those times, in large quantities. The

building owners, by the use of a storage battery, can buy the energy necessary for each day during those times when the price of public supply is least, and thus secure their electric service at a lower cost than that at which it can be generated in the isolated plant. Allowing an efficiency of 85 per cent. for the battery on an average, the actual cost to the building of electric supply will be $3 \div .85 = 3.53$ cents per kw-hour, exclusive of interest, depreciation and care of the batteries.

Without going into the actual first cost of engines, boilers and dynamos for an isolated plant and that of batteries for the same maximum rate of work, it may be said without fear of error that the difference of interest charges on the two equipments would be a very small per cent. of the yearly cost of current in any case. The care of batteries is trifling in expense compared with the operation of an isolated plant of boilers, engines and dynamos, and could often be intrusted to the janitor of a building, under the direction of the central station or that of a consulting engineer. Battery depreciation and repairs for the kind of service now considered is easily held within 10 per cent. per year on first cost, the makers being usually willing to maintain them at this figure. If the cost of 3.53 cents per kw-hour above found for energy alone be increased to 4 cents in order to cover attendance, interest and maintenance, the allowance will be ample. At a cost of 5 cents for energy developed by an isolated electric plant, per kilowatt-hour, the annual outlay is 25 per cent. greater for the same service than with the battery on the above showing.

It by no means follows from the above conclusions, however, that were the batteries necessary to operate the maximum load at the building installed at the central station, the station management could or would supply the building at the rate of 4 cents per kw-hour during periods of maximum load. Neither is it true that it would pay the central station to operate a large part of its maximum load with storage batteries there, simply because a saving is made by the building owners in the above case.

The conditions of public demand for electrical supply are such as to create an advantageous opportunity for those who are able to receive their necessary daily amount of electric energy during those hours when the great majority of consumers cannot. The storage battery enables a consumer to avail himself of this opportunity. Since the maximum load of a public supply station usually continues for two or three hours per day, and during a large part of the twenty-four hours the demands of consumers are very light, a large part of the generating machinery is idle for a large part of the time. Any load that the central station can secure beyond the small normal amount, during the periods of minimum public demand, is evidently a clear gain by any amount that the selling price exceeds the actual cost of production, as to operating expenses, all fixed charges being neglected. Now the fixed charges for a station with an expensive distribution system are a large item in the total cost of operation, so that service which requires no increase of investment may well be rendered at a large reduction from the normal rate.

Apart from the relative advantage between the private consumer and the public supply company, there is a decided and positive advantage in the location of the battery on the premises of the consumer rather than at the generating station. This advantage arises from the lower first cost, higher operative efficiency and superior service that obtains for the conductors between the generating station and the point of use when the battery is located at that point. The cost of the distribution system is usually a large per cent. of that for an entire central-station equipment. Figures for one of the largest Edison systems in the United States show the cost of electric lines to be the largest single item of investment and larger than all others combined, outside of real estate. For another public plant in a city of moderate size the investment in electric lines exceeds that of all other kinds.

In the design of a system of electrical distribution it is, of course, necessary to weigh the disadvantages of a high per cent. of loss in conductors and unsatisfactory regulation of pressure, against a large first cost for copper. Whatever the size of conductors selected, they must be proportioned with special view to the conditions at maximum load, since the per cent. of loss and the troubles incident to lack of pressure regulation are then the greatest. For a given per cent. of loss, the larger the maximum load the heavier must be the distribution system, or with a certain system of conductors, the larger must be the loss.

The efficiency of a system of electrical conductors depends not only on the total amount of energy that they transmit per day, but also on the distribution of the energy as to time. The per cent. of loss in a given system of conductors that transmit electric energy at constant pressure varies directly with the amperes flowing at any time. Suppose that a certain set of conductors will transmit a given amount of energy per day, at a uniform rate during the twenty-four hours, with a loss of 4 per cent. If, now, this same amount of energy must be transmitted over the same conductors in three hours, or eight times as fast, the per cent. of loss will be eight times as great or 32 per cent.

The location of a battery at the generating station may, if the battery is large enough, enable the station machinery to be operated almost constantly at its maximum output, but this position of the battery can alter neither the per cent. of loss at maximum delivery of energy through the conductors, nor any variation of pressure arising therefrom, on the consumer's premises. This consideration tends to materially limit the capacity of batteries that may profitably be employed at generating stations.

When the battery is shifted to the premises of the consumer, his supply of energy can be delivered at times of minimum, instead of, largely, at times of maximum loss on the transmission lines, and the investment in conductors, so far as that consumer is concerned, is much less than would be necessary with the same battery at the station. Unless a very large reduction is made in the size of conductors, compared with those used with the battery at the generating station, the transmission loss will be less when the batteries are located at the point of service. With batteries located entirely at the generating station the problem of accurate pressure regulation on the service to distant consumers at maximum load is a serious one and cannot be solved with entire success. When the batteries are at the point of service, however, the regulation at their terminals is very nearly perfect.

So great is the advantage of batteries at or near the points where electric energy is delivered to the consumer, that public supply companies, working on the direct-current, low-pressure system, now locate by far the greater part of their batteries at distant locations in their distribution system, instead of at the generating station. These battery substations are clearly an additional investment, at least for the real estate, over batteries at the generating plant, but the increased economy of operation, the lower outlay for conductors and the superior regulation of the pressure at consumer's premises more than offset the expense of substations, as is shown by their extending use. Batteries at substations are charged at times when the demands on public supply are small and discharged at times of maximum load, also at some times of minimum load, when the generating machinery is not in use. The main generating station, of course, operates in multiple with the batteries, at substations, at times of minimum load and the per cent. of the maximum output carried by the batteries will vary in different plants.

The ampere output curve for a very large generating station, now before the writer, shows an average load during the entire twenty-four hours of about 70 per cent. of the maximum load, in spite of the fact that the output curve for the system to which this station belongs has a maximum of more than twice its average. The generating station just named supplies all of the energy for a very large, low-pressure direct-current system, feeding several battery sub-stations and also directly into the service mains.

A large private battery plant is virtually a substation, with this in its favor, that its load is very close at hand. The great majority of consumers are not in position to install a private battery because of their small requirements, or from other reasons, and the unequal distribution, as to time, of demands on the public supply seems likely to continue. With the present requirements for public electric service, central and substations must continue to carry a combined capacity of generators and batteries much greater than that necessary for average, to say nothing of minimum loads. Until the usual proportion of generator capacity to total output is much less than at present, central stations can well afford to offer rates to large users, at times of minimum load, than warrant private investment in heavy batteries.

Niagara Power.

It is said that about one-sixth of the total power used in Buffalo comes from the falls. The United States government now proposes to use the current in the new post office, and in many other ways the use of Niagara current is rapidly extending.

The Obsolete in Telephone Work.

BY N. H. HOLLAND.

There are a great many things in telephony that seem to be used for no other reason than because it was the custom to use them at some distant period when they were considered to be of value in the art; although the reasons for their original adoption have disappeared, or have proven to be untenable. This is found to be the case in the winding of some magnets used in telephone service. In a great many cases we find people clinging to an arbitrary winding for certain coils, just because they have been used to obtaining them so wound; notwithstanding the fact that a different winding would give better results. In this respect, nevertheless, we find a gradual improvement, and the intelligent telephone manufacturer usually has definite reasons for what he specifies, as much so as the dynamo manufacturer has in winding a machine for a certain output. There is one of these old superstitions, as we might call them, which is, however, yet very much in evidence. I refer to the familiar spark-gap lightning arrester usual on most telephone instruments, consisting of metallic plates with saw-teeth edges in close proximity to each other. The idea or principle upon which these are supposed to operate is perfectly correct; and indeed a spark-gap arrester is still conceded to be the only device to protect a telephone from lightning. It is the particular form of the arresters in question that is objected to. The idea of the device is that one of the plates being connected to earth and the other or others to line wires, the lightning discharge on the lines will jump the small air gap which has scarcely any impedance, in preference to going through the instrument, which, of course, offers a very high impedance to a current of that character. For an arrester of this kind to be of service, however, it is of vital necessity that an accurate and close adjustment should be maintained. This is impractical in the usual telephone form, as is apparent and might be expected from being mounted on a wood base. And again, if the discharge did happen to jump the plates, the probabilities are that it would heat them up so much that the woodwork would catch fire. This was a corparatively common occurrence a few years ago. The reason this does not occur oftener now is because of the fact that although the arrester is still placed on telephone instruments by manufacturers, it is rarely indeed that it is ever connected in use. I think I am safe in saying that not one in one thousand of the instruments connected in service to-day utilize this device.

Another fallacy is that the subscriber can make use of the plug usually provided with these arresters, and will short circuit his instrument on the approach of a storm. The folly of this will be appreciated by all who have had practical experience in exchange work. When subscribers are so instructed, it is found that the probabilities are that they will recollect the danger to their instruments on the approach of a small shower and follow directions as to inserting the plug, although the number who will remember to do this when a real lightning storm approaches is comparatively few. Again, those who have remembered to insert the plug will more than likely forget to remove it when the danger is over; and many and many are the trips that inspectors have had to make to remove these offending plugs, when the subscribers, instead of admitting their mistake, will be indignant at the loss of service they have experienced. While this is extremely annoying and troublesome if it happens to exchange telephones, it becomes a much more serious matter in a multiple toll line, as any instrument that may be thus short-circuited will prevent any service on the line and thus will disarrange all others who may have connection with the circuit. Moreover, it often means a long chase and an expensive one to find out where the trouble is.

Of course you can remove the plugs so that subscribers cannot obtain possession of them, and this is very often done in sending instruments to be installed. This unfortunately does not entirely remedy the evil; for the metal plates still remain and these are continually getting short circuited by parties who lay keys, pens and other metallic objects on the convenient shelf afforded by the top of their magnetos, while quite often metallic dust or small particles of metal will find lodgment between the plates, making trouble most difficult to locate. As there are now in the market protecting devices which prevent damage to telephone apparatus by lightning, heavy current, or the troublesome sneak current, and as these are always used by any person who really desires protection of the apparatus, it would seem that these old plate arresters as mounted in the usual manner should be dispensed with. Of course there are many who will feel as if they were parting with an old friend and that the telephones will not seem complete if these saw-teeth plates are not mounted thereon; nevertheless these persons will probably more quickly realize the real uselessness of them. In these days when apparatus is being simplified as much as possible and the tendency is to do away with all unnecessary parts, it would certainly seem that nothing should be allowed to remain which is likely to cause trouble unless it has overwhelming advantages. For this reason, I ask: "Does their value justify the retention of these arresters?"

Buildings and Plans for the Pan-American Exposition.

We are indebted to Mr. Frank C. Perkins, of Buffalo, and to the authorities of the Pan-American Exposition for the views here presented of the proposed Machinery Hall and Transportation Building, and that of the Plaza with the trolley terminus, railway station and entrance to the "Midway."

The Machinery Hall and Transportation Building was designed

FIG. 1.—THE PLAZA; ENTRANCE TO TROLLEY STATION.

by Architects Green & Wicks, of Buffalo, N. Y. This building is 500 feet long and 350 feet wide, and faces the Mall. These structures form a hollow square, with arcades on all sides, and are designed in the style of the Spanish Renaissance, similar to the mission buildings seen in Mexico and California. The interior court is 200 feet long and 100 feet wide, and is to be adorned by a large pool of water, with an electric fountain, surrounded with shrubs and flowers, and a very fine opportunity will be given here for electrical effects. Green & Wicks are also designers of the Electrical Building, the view of which is not yet ready for publication.

The roofs are of red tile, the walls of cement, and the work is to be highly ornamented, the structures being covered with glowing colors, the reds and yellows to be in light tints. The openings are grated with wrought-iron grill screens similar to those of the sixteenth century Spanish architecture.

All the towers, pavilions and other spaces of these buildings are to be brilliantly illuminated with electric lights, furnished by the power from Niagara Falls. The buildings, while having many entrances, will have four principal ones in the centre of each façade. Flowers, vines and shrubs blending with the colors of the building

will be placed to ornament the loggia, balconies and pavilions, and they will also be decorated with handsome banners and flags.

The Plaza, showing the entrance to the railway station, and the Midway (to be called Vanity Fair), was designed by Architects Babb, Cook & Willard, of New York. The electric trolley station outside and at the north of the Plaza, seen in illustration, is to be finely equiped, and from this point it is expected that the greater number of visitors will enter the exhibition grounds.

On the south side of the Plaza is to be placed the electrical tower, which is to be designed by Mr. Havard. The stadium, or athletic field, shown in the illustration of the Plaza, resembles that erected

FIG. 2.—MACHINERY HALL AND TRANSPORTATION BUILDING.

at Athens, Greece, a few years ago. It will hold 25,000 people, and has a quarter-mile track, with space inside for athletic games. The exits are very large and seven in number, beside the principal entrance on the west. These are made very high and broad to allow the electrical floats and vehicles to enter without difficulty, as at the stadium it is proposed to have certain pageants at various times during the exposition. Exhibits of electric vehicles and various automobiles will be shown in operation, as well as agricultural machinery and other road apparatus.

The total length of the stadium is more than 870 feet, with a width of 500 feet. The electrical effects to be introduced will be both novel and interesting.

Examination for City Electrical Inspector at Minneapolis, Minn.

The following list of questions was used in the examination of candidates for electrical inspector in the municipal service of Minneapolis, Minn. Answers to 54 out of the 58 questions were required, and a merit mark of 75 per cent. was necessary to pass:

1. What school training have you had? 2. How long engaged in electrical work? 3. With what concerns have you worked? 4. Outline your electrical experience. 5. What is the purpose of the electrical insurance rules? 6. What do they cover? 7. What electrical units are used? (a) define each one. 8. What is Ohm's law? 9. How does it apply to alternating currents? 10. What kind of insulation would you require on circuits of 3000 volts or more? 11. How many open arc lamps in a circuit would bring the voltage to 3000? 12. How many closed arc lamps would be required? 13. How can you tell whether a circuit is properly fused? 14. How can you determine the carrying capacity of a fuse? 15. How can you tell the carrying capacity of a wire? 16. How is electricity generated in a direct current dynamo? 17. How is electricity generated in an alternator? (a) What is an exciter? (b) Where does it get its force? 18. What is meant by "hazardous processes" near which generators must be not placed? 19. How would you determine whether an old wooden switchboard should be condemned? 20. What is an equalizer? 21. What is a lightning arrester? 22. How can you tell whether a lightning arrester is intended for telephone, for arc light, alternating current or for street railway? 23. Should the wires near a lightning arrester be coiled? (a) If so, where and why? 24. Should the ground wire of a lightning arrester be protected by an iron pipe? (a) Give reason. 25. Explain the care to be taken with oily waste as specified in Section 9, division 6 b. 26. Show how to detect grounds on a circuit. 27. Why must ground wires from detectors not be connected to gas pipes within buildings? 28. How can the resistance of ground be measured? 29. How can the insulation resistance between two wires be measured? 30. Explain the operation of an electric motor. 31. How would you construct an insulating platform around a generator or motor? 32. How can you tell whether the wires to a motor have sufficient carrying capacity? 33. What is meant by an automatic motor starting box? (a) On what principle do they operate? (b) How can they be tested? 34. What is meant by running lamps or motors in series-multiple or multiple-series? 37. Why from an insurance standpoint should storage battery rooms be thoroughly ventilated? 36. Why and how should tie wires be insulated? 37. How can you tell whether lines are "unused"? 38. Explain the effects of taping an unsoldered joint? 39. How and why should the metallic sheath of a cable be grounded? 40. Show in detail a practical method of determining the height of a pole or wire? 41. How can you tell whether any fixture for the support of wires is suitable for withstanding the strain to which it may be subjected? 42. Where is electrolytic corrosion most apt to occur? (a) How can this be minimized? (b) What does the amount of corrosion depend upon? 43. How can you determine whether the drop on the return circuit of the street railway is greater than the maximum allowed? 44. How would you conduct an electrolytic survey? 45. What is a transformer? (a) What governs the primary current? (b) What governs the secondary current? 46. What is meant by Section 11, Subdivision 2 b, relating to shunting around catch boxes? 47. What is meant by "B. & S. G."? (a) By "B. W. G."? (b) By "A. W. G."? 48. What is meant by circular mil? 49. How can you tell whether a fuse block is suitable for a certain circuit. 50. What is underwriters' wire? 51. What are conductors? 52. When using iron conduits why should both wires be in the same pipe. 53. If a circuit or dynamo shows an excessive amount of static electricity, would you consider it a risk? (a) How would you get rid of it? 54. What kind of wire would you advise for use in a boiler or engine room? (a) Why? 55. Should conduits and fixtures be made water and gas tight? (a) Give reasons. 56. What is meant by the table in city electrical ordinance, Section 18, Subdivision 1. a? (a) Should the insulation of incandescent circuits increase or decrease as the number of lamps increases? (b) Give reasons. 57. Give diagram of circuits showing how to control an incandescent lamp from three different places. 58. How would you test combination fixtures with electric gas lighting attachment?

Trolley and Steam Competition in New York State.

It is stated that the overhead trolley system promises to be a dangerous competitor with the steam surface roads in some parts of the State, at least. The liveliest kind of a war is being waged between the Delaware & Hudson Canal Company and the trolley roads in Northern New York which are controlled by ex-State Treasurer A. B. Colvin, Joseph A. Powers, of Lansingburg, and others. The latter have a trolley road running from Waterford, Saratoga County, and connecting with the Troy and Albany systems, Mechanicville, Stillwater, Schuylerville and Greenwich. It parallels the Delaware & Hudson road from Troy to Mechanicville, and also the Fitchburg Railroad and Greenwich & Johnsonville Railroad at points farther north. In the early spring it is proposed to build a spur from Schuylerville to Fort Edward, a distance of twelve miles, where the trolley will connect with the Colvin-Powers system to Sandy Hill and Glens Falls. This latter system is also to be continued to Warrensburg, if the State Railroad Commission, at its meeting during this week, will grant the petition of Mr. Colvin and his associates.

Ex-Treasurer Colvin says: "The Delaware & Hudson Canal Company is putting on half-hourly trains between Troy and Mechanicville, but we are carrying ten passengers to their one. We are not in the least alarmed, and we propose to go in for all the passenger, express and freight business in sight. Our road to Greenwich will be completed by the first of the year, and in the early spring we propose to run a line from Schuylerville to Fort Edward. There is a line from Saratoga to Ballston, and we propose to get in there. We have applied to the State Railroad Commission for permission to build an extension from Glens Falls to Warrensburg. The Delaware & Hudson's nearest station to the latter place is Weaverstown, which is five miles away. If our plans do not miscarry, and we do not fear that they will, we will have a continuous trolley line from Albany and Troy to Saratoga, and the Lake George region. The Delaware & Hudson may beat us on the time schedule, but we can run cheaper than they can, and make

more stops. Then, too, we traverse cities, towns and villages, while their cars run on the outskirts." The Delaware & Hudson station at Mechanicville is quite remote from the village proper, and the trolley cars running to the station fail to make close connections in nine cases out of ten.

Some New Telephone Patents.

Among the patents of Dec. 19 are four in the branch of telephony, one being issued to Elias E. Ries and the other three to Frank B. Cook. The Ries patent is on an automatic switching device within a hand telephone receiver. Circuit connections are made within the receiver by means of mercury. In its normal position the mercury makes a contact establishing the signaling circuit, and when the receiver is placed at the ear, by means of the mercury the circuit connections are automatically changed from the signaling to the speaking circuit. Another attachment to the receiver enables a calling signal to be sent over the line by the person using the telephone, either preparatory to or during the process of using the instrument and without recourse to the usual magneto calling apparatus, thus dispensing with the stationary or fixed gravity hook switch heretofore employed. There are thus combined the various instrumentalities for signaling, switching and receiving in the form of a single portable apparatus. Referring to Fig. 1, the instrument is in its normal position with the signaling circuit cut in. When placed to the ear, the mercury runs to the cylindrical part of the mercury chamber and establishes connection with the speaking circuit; by pressing the key shown on the end of the knob and tilting the rear portion of the receiver, a call can be repeated over the line. One of the Cook

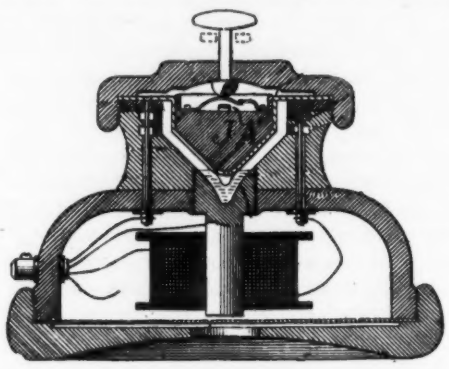


FIG. 1.

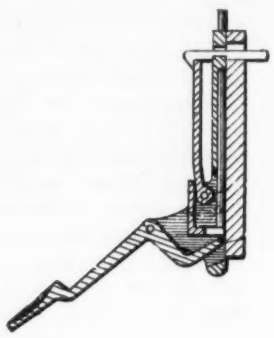


FIG. 2.

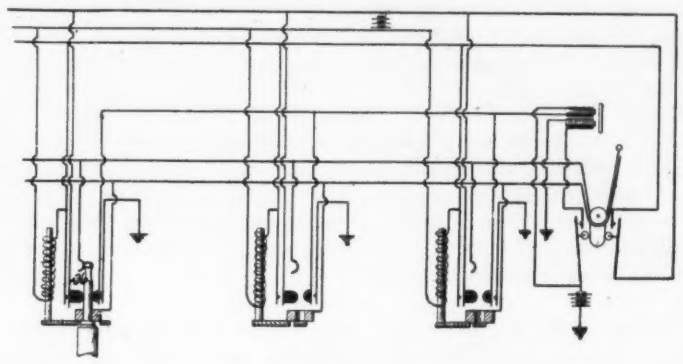


FIG. 3.

patents relates to a drop-restoring device for telephone switchboards, shown in Fig. 2. The drop-restoring devices are separated into parts and so placed on the switchboard that all the drops of each vertical row are capable of restoration simultaneously from one point of operation. The restoring device need not be manually held until the indicator is locked, nor need the indicator be thrown above or below its normal position in time for the catch to operate while the indicators are returning to their normal position. The engaging members each consist of a portion projecting from a lifting rod having an upturned lip, which lip engages the face of the shutter and slides downwardly along the face when the lifting rod is released; the shutter is thus momentarily held in a stationary position after the lifting rod is released, and the engagement of the shutter by the latch is insured by holding the former momentarily in the stationary position referred to. A second Cook patent is on a telephone transfer board, a detail of which is illustrated in Fig. 3. The object of the invention is to provide means whereby when any given trunk line is used at any one section, it becomes impossible to establish connection with that line at any other section while the line is in use, this result being accomplished in the act of inserting a plug in a jack at any one of the sections. In carrying out the invention, spring jacks of peculiar construction are used, having electromagnets mounted thereon, which act upon what may be termed shutters, causing the shutters to assume a position in front of the opening of the jack when attracted by the magnets, and thus closing the jack against insertion of a plug, the shutter returning by gravity into position away from the said opening of the jack to open the jack to the insertion of a plug. The shutters are normally in a position away from the opening of the jack, and therefore a plug may be inserted in any one of them. The act of inserting the plug into any one of the jacks closes two local circuits, which include a signaling device, a source of current and the electromagnets of all the jacks of that circuit; thus operating a signal and energizing all the electromagnets of the jacks, which in turn are closed to the insertion of any plug, thereby preventing any operator from encroaching upon that line which is in use. The third patent of Mr. Cook relates to an improvement in circuit arrangement whereby it becomes necessary to first remove the hand telephone from the switchboard before signaling to the generator; and as the natural tendency when removing the telephone is to place it to the ear, the serious annoyance will be overcome which is often experienced by one party who is using a line and holding conversation, through being interrupted by another party on the same line. The invention consists in the provision of a signaling generator in the telephone circuit and transmitter; the generator being provided with a shunt to cut out the resistance of its armature windings; a telephone circuit is provided which opens and closes the telephone circuit including the generator, the circuit being maintained normally open when the hand telephone is in its position of disuse, thus requiring the removal of the hand telephone from its support and consequent closing of the circuit by the switch in order to talk or signal over the circuit; a signal indicator is located in the main branch. There is further provided a shunt circuit around the telephone which is normally open, and also means for closing this circuit when it is desired to extend a signal, thereby diverting the calling current; thus no loud and disagreeable noise will be set up in the hand receiver at the ear of the person using the apparatus; furthermore, there is also provided a shunt circuit about the telephone, which has included in it a resistance relatively less than that of the telephone, whereby only a portion of the calling current is diverted from the telephone, thus permitting a portion of the calling current to pass through the telephone. This arrangement is important in a case where the signal indicator of the station is responsive only to incoming signals; that portion of the calling generator current passing through the telephone at the ear of the user of the apparatus indicating by the sound thereof that a call is being extended, which sound is not disagreeably loud.

Consolidation of the Havana Street Railways.

At a meeting last week all the street railway interests in the city of Havana were consolidated, terminating a contest which has been running more than a year. The Havana Electric Railway Company acquires the rights and stocks of the Havana Traction Company, which becomes part of the Havana Electric Railway Company, the electric company turning over to the traction company certain interests in the united company. It is expected that a complete system of electric railway will be in operation by June 1. The directors of the Havana electric railway are as follows: President, Edwin Hanson; vice-presidents, William L. Bull and R. A. C. Smith; secretary and treasurer, Arnold Marcus. Directors in addition to those above named are P. A. B. Widener, T. F. Ryan, Sir William C. Van Horne, William McKenzie, Frederick Nichols, H. M. Perkins, Thomas P. Fowler, E. H. Androni, William M. Doull, N. Gelats and G. B. M. Harvey. The capitalization of the company remains unchanged, namely, $5,000,000 of preferred stock, $5,000,000 of common stock, and a first mortgage representing $5,000,000 of 5 per cent. fifty-year bonds.

Colonel Harvey, in speaking about the plans of the consolidated company, said: "The total trackage will be about fifty miles, and the electric plant will be about the size of the one in Newark. Havana and its immediate suburbs furnish a population of about 250,000, who will, to a great extent, patronize the road."

With regard to this matter, the statement is made that the announcement of a settlement of all the interests concerned in the ownership of the Havana City Railway franchises was premature. The Havana City Railway Company, in a suit now pending against J. M. Ceballos, Francisco Pla and the American Indies Company, asserts that it owns the De La Terre-Pla concession under conveyance of October 22, 1895. This suit is in the Supreme Court of New York. President Alexander, of the Havana City Railway Company, says that that company has not sold its concession or title to it to the Havana Electric Railway Company, which assumes the contested rights of the Havana company, succeeding the American Indies Company, with full knowledge of the prior claim of the Havana City Railway Company. The last move in the pending suit, Mr. Alexander says, was the overruling of a demurrer by Judge Gildersleeve. The ruling was appealed from and is still to be heard.

CURRENT NEWS AND NOTES.

AN ELECTRICAL FELLOWSHIP.—The late Dr. J. Stanford Sayre, of the United States Navy, provided in his will for a Fellowship in Practical Electricity at Princeton University, to be known as "Class of 1878 Fellowship."

ELECTRICAL ENGINEERING IN MADRID.—Electrical engineering works are to be established in Madrid by a company just formed there with a capital of $100,000. It is stated that telephone appliances will be eventually manufactured at the new works.

A GIFT TO STEVENS.—Dr. Henry Morton, president of the Stevens Institute of Technology, has announced that Mr. Andrew Carnegie has agreed to give $50,000 toward the construction of a new engineering laboratory, as an adjunct to the institute in Hoboken. The plans have been made, and the new building will be begun immediately.

MARCONI IN GERMANY.—According to a press cable despatch, Marconi has entered the employ of the German government. It will be remembered that his press agent announced as the reason for his hurried departure from this country, that the British government had asked his services in connection with wireless telegraphy in the South African campaign.

NEW CABLES TO CUBA.—Two bills granting permission to lay submarine cables between the United States and Cuba were introduced in the United States Senate on Dec. 19. One of them gives the privilege to the Commercial Cable Company, of Cuba, and the other names the United States and West Indies Direct Telegraph Company as the beneficiary.

A LONG DISTANCE MARRIAGE.—A mulatto girl in Winchester, Ky., and a private in the Ninth United States Cavalry, stationed at Fort Wingate, N. M., were married by telegraph and telephone a few days ago. A minister officiated at each end of the lines. It is not explained why both telegraph and telephone were brought into requisition to conduct the ceremony. The telephone is usually sufficient. The distance between the bride and the bridegroom was 1713 miles.

MR. ROBERT J. CAMPBELL.—Some little while ago an item appeared in our Cincinnati correspondence describing the plan of Mr. Robert J. Campbell to develop electrical trade with Mexico, part of the plan consisting in the collection of a fee in advance. Since the publication of that item, we have received letters from several well-known electrical concerns stating that they have paid Mr. Campbell his fee and have either had no results or have never heard from him since. In case any other instances of the kind, affecting Mr. Campbell's business methods are known, we would like to be advised of them.

ELECTRIC LIGHTING BIDS IN NEW YORK CITY.—The Manhattan Electric Lighting Company, the United Electric Lighting & Power Company, the Harlem Lighting Company, the Mount Morris Electric Lighting Company and the Edison Electric Lighting Company have all bid 40 cents per night for arc lamps, and for lighting public buildings 15 cents per kilowatt hour the first two hours and similar reduction for later hours, which are alike. The bids for lighting Manhattan Borough by gas and electricity show a substantial harmony among the gas companies and among the electric companies, and indicate also a tacit agreement between the two interests that may result hereafter in a definite alliance. The bids of all the electric companies but the Brush are alike, and the Brush Company's bid is 5 cents per lamp per night higher than the others.

NEW FORM OF STORAGE BATTERY.—A patent was issued Dec. 19 to Oskar Behrend, of Frankfort-on-Main, Germany, on a means for preventing the active material of a plate from falling off, for preventing the plates from becoming distorted and also for economizing space and lessening weight. The invention consists in separating the positive and negative plates by a material known as "luffah," a layer of which is placed between each two opposed plates until the whole forms one block of a size to allow of its being slid into the receptacle. The receptacle is then filled with dilute sulphuric acid, and under the action of which the luffah layers are still further increased in thickness if they were subjected to pressure prior to their use. As luffah has great absorbing capacity it is not necessary to charge the accumulator with as much electrolyte as is otherwise necessary.

THE PARIS AUTOMOBILE RACE.—It was decided at a special meeting of the Automobile Club of America last week to challenge for the International Automobile Cup, now held by the Automobile Club of France. A registered letter containing the challenge has been mailed, so that it will reach Paris before Jan. 1, in order to comply with the conditions under which entries may be made. A forfeit of 3000f. accompanies the challenge. Mr. Alexander Winton, of Cleveland, Ohio, and Mr. Andrew L. Riker, of this city, have agreed to start in the race, and there is a prospect of finding a third competitor from this country. Mr. Winton will use a road wagon propelled by gasolene, similar to the one in which he made the run from Cleveland, Ohio, to New York last summer. Mr. Riker will use a special racing carriage built by the Riker Electric Vehicle Company, of Elizabeth, N. J. Electricity will furnish the power.

INTERNATIONAL ELECTRICAL CONGRESS OF 1900.—The committee for the organization of the International Electrical Congress, which is to be held in Paris next year, has sent out a circular asking those who intend to be present to send their names to the committee. The Congress is to be held in Paris from the 18th to the 25th of August, 1900. The president of the committee is Prof. E. Mascart and the secretary to whom communications should be addressed is Mr. Paul Janet, whose address is Rue de Stael, No. 14, Paris, France. Any one may become a member of this Congress by stating his intention of being present and upon the payment of the fee, which is 20 francs (about $4). The programme includes the following subjects: Apparatus and methods of measurements; production of electrical energy; transformers; transmission and distribution of electric lighting; electric traction; electrochemistry; electrometallurgy; accumulators; electric furnaces; electrophysiology; telegraphy; telephony and miscellaneous applications.

ARC LIGHT CIRCUIT GROUND DETECTOR.—A patent was issued Dec. 19 to J. F. Stevens on an electric ground detector for constant-current arc light circuits, which enables the resistance of a ground existing on the line to be very simply determined. The instrument is constructed on the principle of the galvanometer, there being a solenoid within which is a magnetized steel vane carrying a pointer with damper. In series with the solenoid is a non-inductive resistance of a proper value. One end of the solenoid is secured to a plug. To the other end is connected the above-mentioned resistance, the free end of which is connected to a second plug. On the instrument are three binding posts, one of which, A, connects to one side of the arc circuit, another, B, to ground and a third, C, to the other side of the arc circuit. These binding posts have connection respectively with a receptacle into which fits the above-mentioned plugs. In making a measurement three readings are taken. First, one plug is placed in A and the other plug in B, and the reading, V, noted; second, the plug in A is transferred to B and the plug in B is transferred to C and a second reading, V_1, noted; third, the plug in B is transferred to A and a third reading, V_2, noted. The values of the above readings are then substituted in a formula, which in the case of a dead ground gives the distance of the ground from the station in number of lamps; and in the case of a partial ground the substitution in another formula gives the resistance.

UNSUCCESSFUL SUBMARINE TORPEDO BOAT.—A Paris despatch states that the optimistic accounts which were printed recently regarding the trial of the submarine torpedo boat Narval are discounted by the fact that an order has been issued to cease work on two sister boats until defects in the Narval have been remedied. The chief difficulty seems to be in changing the motor power from steam when the vessel is traveling on the surface to electricity which is used while she is under water. During the trials it was shown that this change was made slowly and was unsafe.

CHEAP LIGHT.—Any doubt as to the priority of some of the great electrical inventions will be removed by the subjoined: That New York City streets can be lighted for $1.80 per night, or for $600 a year instead of one or two millions, will be most encouraging news for the taxpayers. We refer them to the following special despatch of Dec. 15 from Springfield, O.: Dr. L. E. Niles and L. L. Wooley, of this city, announce that they have discovered an entirely new gas, with which they can make "daylight." The gas is a high explosive, very powerful and at the same time very cheaply generated. The discoverers say that a dozen of these lights would brightly illuminate New York City, and that the cost per night of running one of the lights of 300,000 candle-power would not be greater than 15 cents. Wooley is the inventor of the arc light, the dynamo and 200 other electrical inventions, including the new magneto telegraph, which dispenses with batteries.

WIRELESS TELEGRAPHY IN THE NAVY.—A despatch from Washington states that the Navy Department has decided to make its own experiments in developing wireless telegraphy and to abandon the proposition of Marconi for furnishing the navy with apparatus and other appliances. Rear Admiral Bradford, Chief of the Equipment Bureau, will shortly establish two stations, one at Newport and the other on Coasters Island across the bay from the Newport apprentice school, where classes will be formed to begin the work of developing wireless telegraphy. This decision was due to the terms presented by Marconi, which the naval officers believed excessive, and, besides, there was no appropriation out of which the money could be paid. Marconi, it is stated, offered to supply the navy with twenty instruments at an annual rental of $1000 each, and refused to allow less than this number to be secured. Admiral Bradford was willing to purchase two sets of instruments with which to make tests on ships of the service, but Marconi's refusal to sell that number brought an end to the negotiations. Admiral Bradford believes that by careful experiments the navy will be able to develop a wireless telegraph system that will be superior to that of Marconi. Classes of officers are to be ordered to the Naval War College to undertake the plan. The army is now making its own experiments, and so far, General Greely, the Chief Signal Officer, declares with success.

NEW FORMS OF TRANSFORMERS.—Among the patents of Dec. 19 are three on constructional details of transformers, issued respectively to Arthur Francis Berry, of Market Harborough, England; James W. Packard and Arthur H. Loring and Harry L. Clark. The core of the first-mentioned transformer is made up of thin L-shaped plates. One-half the number of plates for a transformer is arranged with the vertical portion of the L at the centre of a circle, the horizontal portions radiating therefrom. The coils are then placed over the central core thus formed; the other half of the plates are then so arranged as to form a cylindrical squirrel-cage structure. The Packard patent describes a construction of the core which has the advantage that all plates can be formed by shearing sheet metal strips on alternate square and diagonal lines. That is, one end of the metal strip is square and the other is sheared at an angle of, say, 45 degrees. The strips are assembled in bundles, each containing a given number, say, 2, 3 or 4. The bundles are then assembled with the inclined ends arranged alternately with the square ends. This forms mortices at the ends of the parts of the core, which mortices extend only half way through, leaving the remainder or back portion of each end solid and adapted to be grasped by a chuck without danger of bending the plates. The core can be chucked for winding without putting filling pieces in the mortices. The patent issued to Loring and Clark describes a transformer core construction consisting of two sections. One of these sections is U-shaped and the other section is a yoke which abuts against the arms of the former. The two sections are then clamped together. The method of securing the two sections together is such that the smaller section may be removed at any time without disturbing the rest of the core or removing it from the box.

LETTERS TO THE EDITORS.

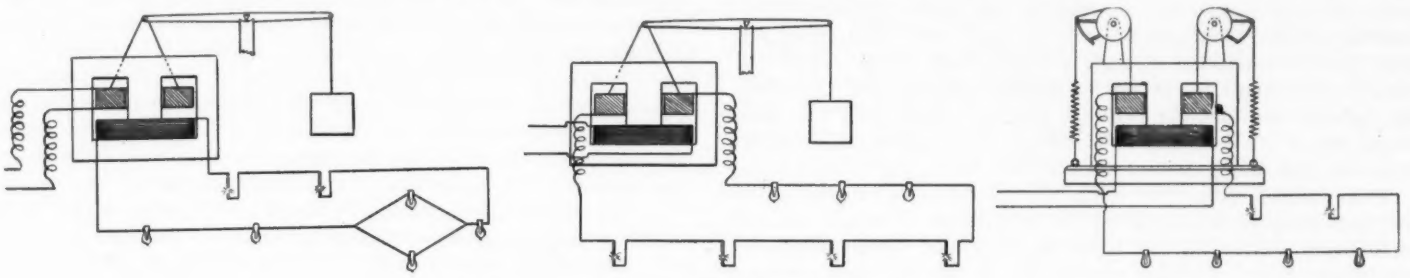
Alternating-Current Series Arc Lighting.

To the Editors of Electrical World and Engineer:

Sirs:—On pages 936 and 937 of your issue of Dec. 16, there is a short article under the title, "Alternating-Current Series Arc Lighting," and drawings are given of a constant-current transformer taken from "Ferranti's British Patent No. 207, accepted in 1894."

Mr. H. W. Clothier, the writer of the article, is evidently unaware of the work which had been done in the United States by myself on constant-current transformers. Your readers will remember the little experiment of the floating lamp as lighted by an alternating-current field and repelled from a field. This was one of the earliest of my repulsion experiments shown in 1887 and subsequently.

In my United States Patents Nos. 516,846 and 516,847, filed June, 1891 (three years prior to Ferranti's British patent referred to), there will be found a number of constant-current transformers, the figures of the patents illustrating the various arrangements and the



ALTERNATING-CURRENT SERIES ARC LIGHTING.

connections of circuits. The primary coil is shown movable in one figure, the secondary in another, and various mechanical balancing arrangements are shown. Both open and closed magnetic circuit iron cores are illustrated. A series of arc lights are illustrated as fed from such transformers.

The first patent named has eleven claims, practically covering the subject matter. I will only quote two of the claims; others are quite to the point, however.

"1. An alternate current regulator comprising primary and secondary induction coils, relatively movable with respect to each other by the repulsive action of the induced and inducing currents, into positions of greater or less inductive action, the said secondary coil being in circuit with the translating devices."

"3. An alternate current transformer and regulator comprising primary and secondary coils relatively movable into position of greater or less inductive action, and tending to assume the position of greater inductive effect, but free to be removed by the repulsive action of the currents into positions of less inductive action, the said secondary coil being in circuit with translating devices."

I enclose tracings of three figures of the first patent. The Ferranti rectifier would, of course, infringe the patents referred to.

LYNN, MASS. ELIHU THOMSON.

Professional Degrees.

To the Editors of Electrical World and Engineer:

Sirs:—The letter of Mr. Rimanoczy has brought out many different opinions as to the conditions under which the degree of E. E. should be granted, and I note that there is always presented the statement, that at least one year's study in a college should be held necessary to obtain the degree.

It seems to me that it is an unjust requirement in some cases. I have reference to the young men who are unable to lose the required time to attend college. There are many cases where the man works during the day, and pursues a course of study and experimenting during the leisure hours at his disposal. The technical papers of the present time lay before him the latest and best engineering practices, and bring out all the latest scientific discoveries of the day, being the source from which most of the colleges receive their first information on the subject.

If he is bright and quick, he obtains a fund of knowledge in many cases equal to that obtained in a college, and has also the practical experience which cannot easily be there obtained.

I do not wish to be understood to imply that a college training is not an excellent thing. What I wish to say is that some method should be provided whereby a man could pass an examination to determine his ability and right to the title of E. E. without a great loss of time, which in many cases he can ill afford.

San Francisco, Cal. Frank Broili.

DIGEST
OF
CURRENT ELECTRICAL LITERATURE.

By CARL HERING.

Dynamos, Motors and Transformers.

Double Current Generators.—Ruthven-Murray.—A long illustrated communication, referring to the articles of Niesz and Thomas (Digest, Oct. 21 and Dec. 23). He points out that no necessity exists for 20 poles, as in the Chicago generators; if the alternating current is to have a frequency of 25, a 100-kw machine running at 500 revolutions per minute may be built with 6 poles only. He describes the use of double current generators for the simultaneous supply of both lighting and traction circuits over a scattered district from a single generator with absolute immunity from risk of short circuits, notwithstanding that the neutral conductor of the three-wire lighting distributors and the negative pole of the traction system are earthed. He considers the case of the generating plant being situated so as to supply direct current to either the lighting or the traction mains close by, with one substation. Two courses are described; first, the direct current end of the double current generators supplies the lighting circuits, the alternating current end being connected through step-up transformers to supply the substation; the home traction circuits would be supplied by a step-down transformer and synchronous converter; at the substation separate groups of transformers and converters would supply the power for lighting and traction. Secondly, both lighting and traction currents may be taken from the direct current end of the generator and one service be maintained through a one-to-one continuous current transformer which might conveniently be of the variable ratio type, while the substation is supplied as before; this plan, however, introduces a machine of which the sole function is to render the double earthing possible. If the plant is of considerable size, polyphase alternators, at the full line pressure, would also be provided for supplying the substation, in which case a third method, not using a double current generator, is available, which is to supply both services through separate transformers and converter groups at each end of the system; the efficiency of this system is not quite so high as either of the others, and an extra transformer and converter group is required.—Lond. *Elec.*, Dec. 8.

Lights and Lighting.

Arc Lights in the Drafting Room.—Gebhardt.—A communication in which he points out the disadvantages of the common practice of suspending a 16-cp incandescent lamp directly over each drawing table in a drafting room, as the light is too direct, reflecting a dazzling glare from the paper and casting deep shadows; 32-cp lamps with frosted bulbs mitigate the evil to some extent. The following system recently installed in the main drafting room of the Armour Institute of Technology of Chicago, containing 104 tables, has proved very satisfactory. Nine parallel connected 1200-cp enclosed arc lamps with opal globes and reflectors, one lamp for every 120 square feet of desk surface, are suspended from overhead girders; they take 80 volts and 5 amp. from a circuit of 120 volts direct current. It was found that a height of 7 feet above the tops of the tables gives the best results. The only objection lies in the extravagance of power, as a few scattering students use as much light as a full quota.—*Amer. Mach.*, Nov. 9.

REFERENCE.

Train Lighting.—Some corrections in the description of the Dick system, noticed in the Digest Oct. 7.—*L'Elec.*, Nov. 18.

Power.

Electricity in Mines.—A long abstract of the report of Leproux, who had been sent by the French government to England to study the electric installations in mines and the safety apparatus used there. The impression in general is that English mining engineers were very cautious at first, and are now beginning again to be adverse to the use of electricity in mines. Where dynamos are used in mines, they are either enclosed airtight, or at least are provided with the device of Stockes, by which the collector and the brushes are enclosed in a case which does not allow a flame to pass out; the size of the case is such that neither an overheating of the enclosed parts, nor a destruction of the case by an explosion, is possible; this device is described in detail and illustrated. The cables used are very carefully insulated, and armored with steel wire or steel strips. In many cases the external cover of the cables is used for the return current. Only exceptionally, at the mouth of pits, the cables are enclosed in lead or clay pipes. In England it is believed that the breaking of the globe of an incandescent lamp cannot cause an explosion; the lamps are therefore often not shielded by a safety globe of strong glass, as in Westphalia and in Belgium; in a footnote it is remarked that this idea that protection is unnecessary, is erroneous, as was found experimentally by Heise. Sussman's head-lamps, which are in extended use, are provided with an accumulator, enclosed in a prismatic case of 1.6 square inch cross-section and 6 inch height; the incandescent lamp is enclosed in a strong cylindrical safety globe, containing a small reflector of enameled iron plate. The lamp weighs 4.4 lbs. and burns 10 hours.—*Zeit. fuer Elek.*, Nov. 19.

Driving of Electric Generators.—Friese.—An abstract of a paper read before the Association of German Engineers. While with the earlier dynamos the high rotative speed required, demanded quick running engines, it is now generally conceded that the best economy is attained by larger engines operating at moderate speeds. He discusses the question of speed regulation at some length, also the action of the centrifugal governor and of the flywheel. He describes the connection of electric generators in parallel and illustrates the equalizing effect of two generators by comparison with that of two engines geared in parallel with a certain degree of elasticity in the connections. The use of accumulator batteries for equalizing variations in the load is considered and their analogy to flywheels is shown. The use of gas engines for driving generators is discussed, and although he believes the single-cylinder four-cycle engine unfit for this service, he claims that with two or more cylinders and with proper arrangements for the equalization of the load, there is no reason why the internal combustion motor, with its superior economy, may not come into general use as a motor for dynamos.—From *Zeit. de Ver. deut. Ing.*, abstracted in *Eng. Mag.*, December.

REFERENCES.

Long Distance Transmission in France.—A short article on the

plant, now under construction in Allassac, utilizing the falls of the River Vezere. The power will be transmitted to the cities of the neighborhood and will be used for lighting; the length of the line is 47 miles. The whole power available will be 4000-hp and the voltage to be used 20,000.—*L'Elec.*, Nov. 25.

Canadian Water Power Plant.—BRAMBLE.—An illustrated description of the plant of the Granby Consolidated Smelter Co. in the Boundary District, British Columbia, where water power is used to generate electric power.—*Eng. and Min. Jour.*, Dec. 16.

Parsons' Steam Turbines.—An illustrated abstract of the English article noticed in the Digest Dec. 2.—*Elec. Rev.*, Dec. 13.

TRACTION

Paris Underground Electric Railway.—DE COURCY.—An illustrated description of the extension of the Orleans Railway into the city to the exposition grounds, which will be operated by electric locomotives, as noticed previously in the Digest. The current will be taken from a third rail, in most cases placed on the outer side of the main rails, in some cases on the inside, the locomotive being provided with three rubbing contacts. Three-phase current at 5500 volts and 25 cycles will be generated by two 1000-kw generators and will be conducted to two substations, each having two groups of machines, one transforming to 550 volts direct current for traction, the other to 500 volts for lighting and the auxiliary circuits in the tunnels and stations. Each group has a capacity of 100-kw and consists of a three-phase synchronous motor taking the full potential, direct coupled to a 500-volt generator. A storage battery is connected in parallel across the busbars.—*West. Elec.*, Dec. 16.

Paris Tramways.—An abstract of a report of the Board of Managers of the Metropolitan Railway Co. of Paris. The total length of the line, now under construction, is 8½ miles. In the power house there will be three dynamos, each of 1500-kw, one generating current at 600 volts, the other two, three-phase current at 5000 volts for transmission to a substation containing eight transformers and three converters.—*L'Elec.*, Nov. 18.

Electric Railroad in Belgium.—A note on tests made with accumulator cars, carrying 75 passengers, on railroad lines radiating from Antwerp. The trip from Antwerp to Brussels can be made without recharge on the route, the normal speed being 47 miles per hour. A projector is carried in front, illuminating the road for a distance of 500 feet. The trial is said to have been successful.—*Sc. Amer.*, Dec. 23.

Eddy Current Brake for Tramways.—An illustrated description of a new brake made by the Helios Co., and used on the Landsberg tramways. An electric and a mechanical method of braking are used, the former alone at high speeds, both combined at slow speeds. The brake consists of a system of six alternate poles of electromagnets arranged in a circle around the axle ot the car, and of an iron armature in the form of a ring around the axle opposite to the magnet poles, for closing the magnetic circuits. The poles are fixed on the frame of the car; the armature is fixed on the axle and rotates with it; it is able also to move along the axle, and by a special mechanical device which is based upon the action of the centritugal forces and works automatically, the armature is moved nearer to the magnets when the speed decreases, and is farther from the magnets when it increases; the electromagnetic attraction on the armature is in the same direction as the action of the mechanical device for decreasing speeds, and opposes it for increasing speeds. As the Landsberg tramway cars have only one motor, the second axle was supplied with the brake. During the time of braking, the current for the electromagnets is supplied from the motor, which is then connected as a generator, so that there is a braking action on both axles. For decreasing speeds the exciting current of the electromagnets also diminishes, but at the same time the armature is moved nearer to the poles, so that the reluctance of the magnetic circuits is diminished and the braking action of the current is not lowered. The armature is ultimately pressed mechanically against the poles, so that there is then also mechanical braking. This method is said to have proved so successful in Landsberg that it may be introduced generally on the tramway lines installed by the Helios Co.—*Elek. Zeit.*, Dec. 7.

Automobiles in Russia.—BENJAMIN.—After describing an electric process for making alcohol, which is largely used as a fuel (see the abstract under Electrochemistry), he says that the automobile is becoming quite common in Russia, while in France it is not making the progress that is desired. A new method of making accumulator plates, which is used with success there, is to fill the lead grid with a mixture of lead protoxide, lead chloride and diatomaceous earth, which is said to be one of the most highly absorbent materials known, and is unaffected by acids; this forms very porous plugs. Compressed air is also used; one method of reheating it being to drive a small dynamo, the current from which passes through coils in the path of the air flowing to the engine.—*Elec. Rev.*, Dec. 13.

Motor Car Trip.—A short note on an electric motor car trip from London to Brighton, a distance of 55 miles, with one battery charge, the average speed being 11 1-3 miles per hour. The car was equipped with 40 Leitner lead-zinc cells (see Digest, Dec. 23), and the voltages on open circuit at start and on arrival were 94 and 84 respectively.—Lond. *Elec.* and *Elec. Eng.*, Dec. 8.

REFERENCES.

Automobile Accumulators.—BAINVILLE.—The conclusion of his series of articles on the prize competition for automobile accumulators under the direction of the Automobile Club of France (Digest, Nov. 4). The results of the tests from the thirteenth to the sixteenth week are given in a table, and some modifications which have been found to be necessary in the programme of the tests, are briefly discussed. No summary of the results is given.—*L'Elec.*, Nov. 18.

Automobile of the Fire Department in Paris.—An illustrated description of this automobile, referred to in the Digest Sept. 23 and 30.—*Sc. Amer.*, Dec. 23.

Aluminum and Platinum for Motor Cars.—A short article on the use of aluminum and its alloys, especially with platinum (Digest, Oct. 21), for motor carriages.—*Sc. Amer. Sup.*, Dec. 23.

INSTALLATIONS, SYSTEMS AND APPLIANCES.

Electric Lighting at Windsor.—An illustrated description of the street lighting, in which some ten arc lamps of 2000-cp, 26 of 500-cp and over 300 incandescent lamps are in use, and more of the latter are to be installed. These incandescent lamps are lighted and turned out from a central point in the town. This is accomplished by means of subsidiary mains, the lamps being connected between them and one conductor of the ordinary cable. About 20 lamps are grouped in parallel with one subsidiary main, the end of which is connected with a relay which automatically connects a second subsidiary main of the same size to the other conductor of the main cable, and so on. The relay consists of an electromagnetically operated lever and a mercury switch. The relay and the connections are shown in diagrams. For private lighting the equivalent of 12,000 lamps of 8-cp are connected with the station. The charge for current is 13 cents per unit until the annual bill averages $3 per 8-cp lamp installed; any consumption in excess is charged for at 7 cents per unit.—Lond. *Elec. Eng.*, Dec. 8.

Greenock Lighting Plant.—A description of this recently-opened English plant. There are two steam driven bipolar dynamos, each having an output of 200 amperes at 300 volts, and a bipolar dynamo giving 300 amperes at 600 volts. The speed of the smaller set is 450 revolutions and of the larger 420, with steam at 200 lbs. per sq. in. As a tramway load is anticipated in the early future, the field coils of the larger generator are compound wound, the series coils being then cut out. The voltage on the outers of the lighting system is 500. There are two boosters, running at 750 revolutions, with 75 amperes at 300 volts, at the motor side, and 120 amperes at 150 volts at the generator side. The accumulator battery consists of 304 Tudor cells with a capacity of 180 hours, divided into two batteries of 152 cells on each side of the three-wire system.—Lond. *Elec. Eng.*, Dec. 8.

Burnley.—The conclusion of the illustrated description noticed in the Digest Dec. 23. When the proposed change from 220 to 440 volts is made, the accumulator battery will consist of 240 Tudor cells, giving 1120 or 960 or 864 ampere-hours, if discharged in 10, 5 or 3 hours respectively, the full specified capacity being guaranteed for ten years. The switchboards are described and illustrated. In the distributing network the existing mains are single conductor lead-sheathed armored cables; for the recent extensions vulcanized bitumen cables are used, laid solid in bitumen in a strong wooden trough.—Lond. *Elec. Eng.*, Dec. 8.

Costs of Central Lighting Plants.—The conclusion of the article noticed in the Digest Dec. 9. Concerning accumulators it is said that perhaps the best way to rate the first battery is to allow 2½ ampere-hours per kw of generating plant laid down, thus for 9000 lamps installed, three 90-kw steam dynamos are laid down, and this gives 680 total ampere-hours, hence the battery should be capable of giving 85 amperes for eight hours, i. e., from 12 midnight until 8 the next morning. In any central station at least one of the staff should have had an intimate experience either in the manufacture or repair of accumulators.—Lond. *Elec. Rev.*, Dec. 8.

Determination of the Most Favorable Number of Distributing Points of a Network.—Sengel.—The conclusion of his mathematical article (Digest, Dec. 9) in which he calculates the case of a network formed by regular hexagons. For all special cases which he has calculated, the formulas found for the most favorable number of distributing points, and for their relative distances, agree so well with each other and differ only slightly in the values of a constant, that he draws the conclusion that the general case is represented by a formula in which the constant is taken as the average value of the slightly differing values of the special cases. The formulas seem to be practical, but cannot be given here. Their application is explained in two examples.—*Elek. Zeit.*, Nov. 23.

Methods of Suppressing Arcs in Switches, Fuses, Etc.—E. K. Scott.—The first part of an illustrated paper read before the Northern Society of Electrical Engineers, dealing with switches. The best switch contacts should have as low a resistance and as high a melting point as possible. Carbon is one of the most refractory of conducting substances, but as a good contact cannot be depended upon, it is best to use it as a subsidiary contact block in shunt with the main switch which is to be opened first. The following methods are briefly described: Multiplication of breaking points; pneumatic blow-out; to stop arcing by partial vacuum, which method is used at the central station of the Burgdorf-Thun three-phase railway, the switch contact being driven into a ebonite tube, into which it fits fairly closely, and at the bottom of which there is the other contact; the magnetic blow-out of Elihu Thomson; the solenoid blow-out controller, as used at the Central London Railway, which is described at some length with four illustrations; the Hopkinson and Wood magnetic blow-out; the Oerlikon series-parallel controller; the G. E. car lighting switch and fuse; a combined solenoid blow-out and fuse, consisting of a fuse wire carried round a porcelain block many times and attached to terminals at either end, thus forming itself a solenoid; a circuit-breaker with a shunted fuse.—Lond. *Elec., Elec. Rev.* and *Elec. Eng.*, Dec. 8.

Wires, Wiring and Conduits.

Edinburgh Mains.—A short, well illustrated description of the mains and conduits laid down in the neighborhood of the new lighting station, referred to in the Digest Nov. 18 and 25. The cross-section and side elevation of the conduit, the details of the insulators and supports, and the plan and elevation of subway and connections to generating station, are given in diagrams. Pure copper strips, 2 inches broad by ¼-inch thick, are supported on stoneware insulators, bolted onto channel irons placed at intervals of 10 feet along the conduit.—Lond. *Elec. Eng.*, Nov. 24.

Electro-Physics and Magnetism.

Moving Bodies in an Electric Field.—Heydweiller.—An account of an experimental investigation. If a sphere rotates uniformly in a medium of different conductivity and in an electric field, and if the conductivity of the medium is negligible in comparison with that of the sphere, a couple acts upon the sphere tending to stop its motion; if the conductivities are reversed, the couple tends to accelerate the motion. He found that the phenomena in air are complicated by its dielectric conductivity which increases with increasing field intensity and decreasing density, and therefore can be greater or less than that of a glass sphere suspended in it. He makes an application to the motion of celestial bodies which may be regarded as conducting spheres suspended in a con-conducting medium strained by a feeble electrostatic field, and shows that if the earth's potential was 10,000,000 electrostatic units as at present, or 1000 times higher, for 100 billion years, the field thus created would account for the stoppage of the moon's rotation without having to resort to a supposed tidal action.—*Wied. Ann.*, No. 11; abstracted in Lond. *Elec.*, Dec. 1.

Chemical Action of Becquerel Rays.—P. and S. Curie.—A paper describing some chemical effects caused by Becquerel rays. Besides some other things, they convert oxygen into ozone. If any radiant substance is kept in a stoppered bottle, on opening it, the characteristic smell of ozone is perceived; after being dissipated slowly, it is strengthened again on closing the bottle for ten minutes. The presence of ozone is also proved by the coloring of a mixture of starch and potassium iodide spread on a piece of paper.—*Comptes Rendus*, Nov. 20; abstracted briefly in Lond. *Elec.* Dec. 8.

Thermo-Electricity.—Viles.—A short communication in which he describes what is called a thermo-couple without junctions. A low resistance galvanometer is short-circuited by a foot of No. 20 copper wire and a portion of the wire is heated to redness; no current is produced. "Now touch the hot wire with a piece of selenium, wait till the fumes have subsided, and repeat;" the needle then moves off the scale. He points out that there is heterogeneity in the circuit, selenide of copper being formed, and thinks that if this principle were adopted in the construction of thermopiles, it would get over the difficulties which arise through failure of contact at the junctions.—In a very short editorial note it is said that it appears extremely doubtful whether this is really a thermo-electric effect.—Lond. *Elec.*, Dec. 8.

Thermal and Electrical Conductivity.—Kohlrausch.—A German Academy paper in which he shows that the stationary distribution of temperature in an electrically heated body, depends only upon the ratio of its electrical to its thermal conductivity, and upon the difference of potential between the electrodes. From this he deduces a simple and reliable method of determining that ratio and also the thermal conductivity.—*Sitz. Berl. Akad.*, 38, p. 711; abstracted in Lond. *Elec.*, Dec. 8.

Magnetic Qualities of Building Brick.—Gage and Lawrence.—An account of an experimental investigation which was made because the magnetic disturbances existing in some physical laboratories have been traced to the brick work of the walls and piers of the building. The results are given in diagrams and tables; they conclude that the bricks were in most cases found to be permanent magnets of slight and varying strength, that the magnetism is affected by heat and strong magnetic fields, and that the probable cause is the presence of magnetic iron oxide, either a constituent of the clay or formed by heat.—*Phys. Rev.*, November, December.

References.

Distorted Curves.—Goldschmidt.—A description of a rather simple, approximate method of dealing with distorted curves, without dissolving them into a sum of harmonics. The method is mathematical and cannot be described here; it seems, however, to be practical. He applies it to find the curve of current, when the curve of e. m. f. is given geometrically, for given resistance and reactance of the circuit and a given periodicity, and describes briefly the application to some other cases.—*Elek. Zeit.*, Nov. 30.

Masses Smaller Than Atoms.—J. J. Thomson.—The British Association paper in full, an abstract of which was noticed in the Digest Oct. 14.—*Phil Mag.*, December; a reprint is begun in Lond. *Elec.*, Dec. 8.

Frictional Electrification.—Christiansen.—An account of a continuation of his researches on the mechanism of frictional electrification. He studied the difference of potential of jets of mercury and of zinc or other amalgams falling side by side through dry or moist oxygen.—*Wied. Ann.*, No. 11; abstracted in Lond. *Elec.*, Dec. 1.

Kerr Effect.—Abraham and Lemoine.—An abstract of a French Physical Society paper on the instantaneous disappearance of the Kerr effect (see also Digest Sept. 9).—*L'Elec.*, Nov. 25.

Röntgen Rays.—Rollins.—A continuation of his serial, describing the "building of a vacuum;" two regulators may be put on one tube, one to introduce hydrogen and the other water vapor. He also describes a cheap vacuum regulator.—*Elec. Rev.*, Dec. 13.

Dark Lighting.—A summary of some recent observations and researches (see also Digest Sept. 2 and 30).—From Lond. *Eng'ing*, reprinted in *Elec. Rev.*, Dec. 13.

Electro-Chemistry and Batteries.

Spongy Zinc.—Foerster and Guenther.—An account of a series of experiments made to test their former views on the formation of spongy zinc, which they had believed to be due to the precipitation of zinc oxide from the solution. If this is correct, the electrolysis of alkaline solutions of zinc could give no spongy zinc, as in this case no formation of zinc oxide at the cathode would be possible. Their experiments, however, showed a formation of spongy zinc at the cathode in pure sodium lye saturated with zinc, precisely as from solutions of sulphate or chloride of zinc. The formation of spongy zinc was the more rapid, the less the lye at the cathode was stirred; it was of less importance whether the current density was 0.02 or 0.04 or 0.09 amp. per sq. cm., and whether the temperature was 20° or 50°. They therefore discard their former hypothesis and conclude that in general the formation of a certain concentration of ions of hydroxyle besides zinc ions of small concentration, causes the formation of spongy zinc; but they cannot yet give an explanation of this phenomenon. They refer to a similar phenomenon occurring in the electrodeposition of lead. To show the influence of the composition of the solution upon the form of the metallic deposit, they refer to the following observation: If to a 5 per cent. solution of chloride of zinc a slight excess of ammonia is added instead of potassium or sodium lye, a beautiful gray, fine crystalline deposit of zinc is ob-

tained even by an electrolysis lasting some hours; if, however, the solution contains 0.5 gr. zinc per 100 cc. and a higher excess of ammonia, the zinc is deposited in large branched leaves and needles.—*Zeit. fuer Elektrochemie,* Nov. 30.

Electrodeposition of Zinc.—COWPER-COLES.—A short communication referring to the editorial suggestion to try a burnishing method for obtaining good zinc deposits. (Digest, Dec. 23.) He has already experimented in this direction, but found that this method is suitable only for depositing zinc on cylindrical bodies. By his experiments to depost zinc under hydraulic pressure, he endeavored to force the zinc into the pores of the iron, and also to deposit it on irregular objects; his results tend to prove that under pressure there is not the same liability of zinc sponge being formed.—Lond. *Elec.,* Dec. 8.

Electric Process of Making Alcohol.—In some notes on the automobile in Russia, the Villon process of making ethyl alcohol is described, as this material is used largely for fuel in automobiles in that country. It is almost absolutely pure and is made at the low cost of about 8 cents a gallon (the tax on it in the United States is said to be $2.14 per gallon). Limestone and coke are heated electrically to form calcium carbide, and this is used to produce acetylene, which is passed through a warmed reducing salt of the protoxide chrome sulphate type, like the double sulphate of chrome and ammonia, by which it is absorbed, giving off hydrogen; in this reaction ethylene gas is produced and the chromium oxide is reduced; the reducing salt is brought back to its former condition by the action of nascent hydrogen produced electrolytically. The ethylene is passed through sulphuric acid, which absorbs it, forming hydrogen-ethyl-sulphate, to which one-third its weight in water is added; this is heated and gives off ethyl alcohol, which is distilled off. As the carbide sells for $20 a ton in Russia, the process is a cheap one. To prevent its being used for drinking purposes, a material is added to it which gives it a nauseous taste.—*Elec. Rev.,* Dec. 13.

Purification of Water.—In an editorial on the Croton water, a few brief statements are given concerning the Tindel process by means of which 20,000,000 gallons a day are being treated for Paris. The water is sterilized by being brought into contact with ozone; the cost of the treatment is said to be less than 0.028 cent per cubic yard, at which rate the Croton supply of 100,000,000 gallons would cost about $138 per day, or about $50,000 per year.—*El'ty,* Dec. 20.

Voltaic Cells With Compound Electrodes.—SPIERS.—The first part of an illustrated account of a series of experiments. The simplest and most striking is the following: A disc of iron and another of zinc are bound together and the couple is suspended as one electrode in a cell containing ordinary tap water as electrolyte; the other electrode is a brass disc; then the e. m. f., which was measured electrostatically, varied for different positions of the double disc relative to the brass disc. When the iron faced the brass, the voltage was 0.36; when the zinc faced the brass, it was 0.48; when the edge of the couple faced the brass, it was 0.41; the effect was the same, whether the electrometer connection was made to the iron or the zinc. He begins to discuss this phenomenon and shows that the effect observed is not analogous to those obtained in experiments on the volta effect. —Lond. *Elec. Rev.,* Dec. 8.

Sherrin Accumulator.—An illustrated description of this English accumulator, which has successfully survived the recent competitive test of the Automobile Club of France. In the terms of the competition, each competitor had to submit five cells, the whole weight of which in the box was not to exceed 244 lbs.; the capacity had to be 120 ampere-hours; the accumulators were disqualified when the voltage fell below 1.7 volts per cell; the discharge was rather irregular in order to approximate the conditions of automobile work; in the first two minutes 20 amp., in the third 100 amp., in the fourth and fifth 30 amp., from the sixth to the eighth 40 amp., from the ninth to the eleventh 70 amp., from the twelfth to sixteenth 30 amp., from the seventeenth to the twentieth 20 amp., the next ten minutes no discharge; and so on every half-hour. The Sherrin cells are said to be the only survivors at the end of the trials. After 100 charges and discharges the energy of efficiency was 72.2 per cent.; the efficiency at the end of the trial is not yet given. The feature of the Sherrin accumulator is the construction of the positive plate, which is made up of slightly twisted lead strips surrounded by spirals of ebonite; the paste forming the active material is then filled into the skeleton so formed, the whole being enveloped in a wrapping of perforated sheet ebonite. The negative plates are formed of cast-lead grids.—Lond. *Elec. Eng.,* Dec. 8.

Barbier Accumulator.—An illustrated description of this new French accumulator. Each plate consists of the active mass held in a box of antimony lead, the inner surfaces of the two sides being provided with conical points and holes between them, each point of the one surface being opposite to a hole in the other. The active mass consists of finely powdered pure lead, which in this special molecular condition appears after formation to give a crystallized peroxide, similar to that in the Planté type, on the postive pole, and a very spongy lead on the negative. The useful capacity of the battery seems to increase with time; it is said that apparently the life of a battery would be ten years for one charge and one discharge per day, and three years for two discharges per day; this statement, however, is still to be confirmed by practice. The weight of the battery is given as follows: Five positive plates weigh 13 lbs., five negative plates 13 lbs., the electrolyte 7.7 lbs., the tank 6.6 lbs., the connections 0.4 lbs., hence the total weight 40.7 lbs. There are evident typographical errors in the statement of the size of the plates and density of electrolyte. Peuckert's constant was determined in two discharges, one with 24 amp. in 5 hours, the other with 72 amp. in 1 hour 15 minutes, both discharges ending at 1.8 volts; the constant was found to be 1.262.—*L'Elec.,* Nov. 25.

Chemical Equilibrium and E. M. F.—DANNEEL.—An article in which he develops analytically the following law: "The ratio of the solution tensions of two metals is equal to the ratio of the concentrations of their ions at the equilibrium of a reaction in which one metal is precipitated by the other from the solution of one of its salts." (By equilibrium he appears to mean the state when the reaction has been completed.) He has found that this law agrees with experiments in which he investigated "the equilibrium between silver and hydrogen" in hydriodic acid. From this law he also draws the conclusion that all reactions in which two metals compete for any anion, reach the same equilibrium which is characteristic for the two metals.—*Zeit. fuer Elektrochemie,* Nov. 23.

Electrochemical Industry.—BORCHERS.—An illustrated article in which he points out that of the various forms of energy, chemical energy is, with the exception of some forms of mechanical energy, practically the only one which can be stored in transportable form, and "the true function of the electrochemical industry is to give a concentrated and highly potential form to the fleeting processes of the forces of nature." He gives an outline of the development of electrolytic processes in industrial operations during the last thirty years and discusses their future possibilities. He describes briefly, with illustrations, the various methods of producing sodium by the electrolysis of caustic soda, the electrolytic production of magnesium, aluminum, copper, silver, nickel, gold, caustic soda, caustic potash, chlorate of potash, chlorine and white lead; also the production of phosphorus, carborundum and calcium carbide in the electric furnace. Three of the statistical tables of his German Electrochemical Society paper which was abstracted in the Digest Aug. 26 are reproduced.—*Eng. Mag.,* December.

Electrochemistry in 1898.—The first part of a summary of the progress of electrochemistry in 1898, dealing with the production of metalloids. A larger plant for the electrolytic production of hydrogen and oxygen in Hanau, was recently installed by the Schuckert Co., dilute soda being used as an electrolyte, the anode and cathode being separated by non-porous diaphragms, which extend from the top not quite to the bottom; the current is 200 amp., the voltage 2.7 to 2.8; the cost of electrolytic production of hydrogen alone is claimed to be only a third to a half that of the chemical process, even in small plants. A recently patented apparatus of Garutz for the same purpose is briefly described; patented processes for the production of ozone, chlorine, phosphorus, phosphorus simultaneously with carbide of calcium, graphite and silicium are noticed briefly.—*Elek. Anz.,* Nov. 26.

REFERENCES.

Copper Assaying.—ULKE.—An outline of the daily work of the chemist and assayer at one of the largest and best equipped electrolytic copper refineries. He gives brief and exact descriptions of methods to determine free acid and bluestone, arsenic, antimony, iron, chlorine in the solution, copper in copper bullion, on anodes, etc., copper in slags, arsenic in cathodes and wire bars, arsenic in refined copper, arsenic and antimony in copper bullion, gold and silver in copper bullion anodes, wire bars, etc., in blister and refinery slags, and in slimes. The methods described are claimed to be up-to-date. —*Eng. and Min. Jour.,* Dec. 16.

Majert Accumulator.—An illustrated description of this accumulator, referred to in the Digest Dec. 2.—Lond. *Elec.,* Dec. 8.

Galvanic Cell.—COOPER.—An illustrated article discussing the dif-

ferent theories on the seat of the e. m. f. in a galvanic cell. It is interesting, but seems to contain nothing new.—Lond. *Elec.*, Dec. 8.

Theory of Lead Accumulators.—Elbs.—A long French abstract of his German Elektrochemical Society paper and discussion, noticed in the Digest Aug. 26.—*L'Eclairage Elec.*, Nov. 18.

Electrolysis of Phosphates of Metals.—Fernberger and Smith.—An account of a series of experiments in which copper, iron, aluminum, chromium, nickel, mercury, zinc, etc., were deposited by the electrolysis of their phosphates.—*Jour. Am. Chem. Soc.*, 21, p. 1001; abstracted in *Zeit. fuer Elektrochemie*, Nov. 30.

Persulphates of Rubidium, Caesium and Thallium.—Foster and Smith.—A description of a method of obtaining these persulphates by electrolysis.—*Jour. Am. Chem. Soc.*, 21, p. 934; abstracted in *Zeit. fuer Elektrochemie*, Nov. 30.

Complex Salts.—Abegg.—A long French abstract of his German Elektrochemical Society paper, noticed in the Digest Sept. 2.—*L'Eclairage Elec.*, Nov. 18.

Units, Measurements and Instruments.

Alternating Current Energy Meter.—Guye.—An illustrated description of a new meter, devised by Batault, which is claimed to give readings exactly proportional to the watts consumed. It is based upon the reaction of the Foucault currents induced in a movable aluminum disc, the revolutions of which are registered. The rotary field is produced by a special combination of windings. There are two parallel, laminated, U-shaped iron cores, and three different windings; a shunt winding, consisting of two coils of fine wire, each surrounding two parallel arms of the iron cores; a series winding, consisting of two coils surrounding the ends of both arms of one of the iron cores only, in such a way that its magnetizing action tends to produce the same polarity at the ends, that is, both south or both north; and a double secondary winding, consisting of two short-circuited low resistance copper rings, each surrounding the ends of two parallel arms of the iron cores. The action of these three windings is somewhat complicated; it appears, however, that the greater the difference of phase between e. m. f. and current in the main circuit, the smaller is the torque due to the rotary field. The aluminum disc is placed above the poles of the iron cores, and above it there is a soft iron armature which closes the magnetic circuit and allows an exact adjustment of the proportionality between the indications of the meter and the watts consumed, as the reluctance of the magnetic circuit can be adjusted by changing the position of the iron armature relatively to the four poles. The results of a series of tests are given in two tables.—*L'Eclairage Elec.*, Nov. 25.

Measurement of Intermittent, Continuous Currents.—Heinke.—An article in which he points out that satisfactory results in the measurement of intermittent continuous currents or "wave currents" such as those obtained by means of a Wehnelt interrupter, may be arrived at by measuring the potential and current simultaneously "with galvanometric and 'efficiency' instruments, thus splitting them up into a constant term and a periodically variable term. The latter may be replaced by an equivalent sine wave." The total work of the wave current is best measured calorimetrically, by converting the whole energy expended into heat. (See also his article noticed in the Digest under Wehnelt Interrupter, Aug. 12 and 19.)—*Wied. Ann.*, No. 11; abstracted in Lond. *Elec.*, Dec. 1.

Leading and Lagging Currents.—Two illustrated communications describing practical methods for finding whether a current is leading or lagging behind the e. m. f. in an alternating current circuit. If there is a spark on closing the circuit and if there is no spark on breaking the circuit then the current is leading. Another method is to draw the instantaneous values of the e. m. f. and current by means of an instrument, such as Joubert's instantaneous contact device. Another method is the following: An ammeter and an adjustable inductance, consisting of a solenoid, into which strips of iron can be placed to increase the reactance, are in series with the circuit and a voltmeter is shunted across the mains. The impedance of the circuit, which is found by dividing the readings of the voltmeter and by those of the ammeter, is measured for different values of the adjustable inductance; first, by using the solenoid without iron strips and then by gradually inserting more and more strips. If the impedance continually increases, the current is lagging; if it first diminishes and then begins to increase again, the current is leading. (In order that the impedance first diminishes, it is necessary that the reactance of the solenoid without iron strips is smaller than the capacity of the line.) Another method is also described, in which two ammeters, a voltmeter, a wattmeter and a choking coil are used in the following arrangement: The current coming from the alternator goes through one ammeter; a voltmeter is shunted across the mains; the series coil of the wattmeter is in series with the circuit, and the shunt coil across the mains; the other ammeter, in series with the choking coil, is shunted across the mains. The power factor is then determined when the choking coil is connected and when not, and the values of the wattless components of the current in both cases are compared.—Lond. *Elec. Eng.*, Dec. 8.

REFERENCES.

O'Keenan Meter.—A long illustrated paper read before the International Society of Electricians in Paris, describing his meter, which was referred to in the Digest Dec. 9.—*L'Ind. Elec.*, Nov. 25; abstracted without illustrations in *L'Eclairage Elec.*, Nov. 18; Lond. *Elec. Eng.*, Dec. 1; *Elek. Zeit.*, Nov. 30.

Distortion in Alternate Current Instruments.—A reprint of the translation of the article noticed in the Digest Dec. 23.—*El'ty*, Dec. 20.

Commercial Permeameters.—Santarelli.—A long illustrated article describing a number of permeameters for the determination of the magnetic properties of iron, and a new one devised by him, which is a magnetic bridge like the permeameter of Ewing, the arrangement of the circuits, however, being entirely different.—*L'Elettricista*, Sept. 1; a long illustrated French abstract in *L'Eclairage Elec.*, Nov. 18.

Telegraphy, Telephony and Signals.

Efficiency of Telephone Transmission.—Dussaud.—A note describing the results of experiments made by him to find the best conditions for the electrical transmission of sound, through telephone circuits. At the transmitting end it was found advantageous to increase the number of microphone discs and enclose them in a resonance tube in which the vibrating air column could be agitated by the voice; the best results were obtained when the air could act readily onto both sides of the plates. Small carbon blocks separated the plates from each other at the receiving end. The efficiency of the line was considerably improved by increasing the number of facets at the poles of the electromagnet, each facet having opposite it a separate disc, these discs being so arranged that the air column could act on both sides. With this arrangement the efficiency was so good that it was possible to register the sounds on a phonograph. This was proved in a lecture where more than 1000 persons in a hall were able to hear clearly and without missing a single word, the speeches addressed to the transmitter in another room of the same building.—Lond. *Elec.*, Dec. 8.

Automatic Telephone Call Boxes in Copenhagen.—A short illustrated description of this installation with 465 instruments, which has been in successful use for a year; the telephones are in public buildings, theatres and large flats. The exchange can be called up only after a coin has been inserted; in case the exchange cannot make connection, the coin is recovered by pressing a button; disconnection is made automatically by replacing the receiver on the hook. By a special arrangement for receiving extra coins, telegrams can be forwarded through the exchange. The arrangement for receiving the coin, the general connections, the exterior and interior view of the apparatus, and the general view of the apparatus in position are illustrated; the installation is also discussed in an editorial note.—Lond. *Elec.*, Dec. 1; reprinted in *El'ty*, Dec. 20.

Self-Induction of Cables.—Breisig.—An account of a series of measurements made to find how far the self-induction of the cores of cables may be increased by the application of iron in the cable core, in order to overcome the effect of the capacity for telegraphic purposes. The method of the measurements and the results are given at some length. To draw a practical conclusion, he calculated the damping of an alternating current, the periodicity of which corresponds to a speed of 160 letters per minute, in a cable containing only copper and in one in which the self-induction is increased 60 per cent. by iron. For equal e. m. f. and equal heights of the waves at the end, he finds that the cable supplied with iron would allow an increase in speed of less than 8 per cent. He concludes that as the self-induction of cables could probably not be increased in practice by other methods than these, his experiments show that the expected increase of speed by increase of self-induction cannot be accomplished.—*Elek. Zeit.*, Nov. 30.

REFERENCES.

Space Telegraphy in the Alps.—J. and L. Lecarme.—A translation in abstract of the paper noticed in the Digest Nov. 18.—*West. Elec.*, Dec. 16.

Microphone.—BERGET.—A short French Academy note on the application of the microphone to the registration of the course of chronometers and clocks.—*L'Eclairage Elec.*, Nov. 18; *L'Ind. Elec.*, Nov. 25; *L'Elec.*, Dec. 2.

Electric Clocks.—A description of some recent improvements in electric clocks.—*Zeit. fuer Elek.*, Nov. 19.

Safety Contact.—A short illustrated description of a contact device for electric bell signals giving notice of the opening of a door, the contact being adjustable for longer or shorter signals.—*Elek. Anz.*, Nov. 26.

Railroad Signals.—COLEMAN.—A continuation of his long article on electropneumatic interlocking signals at the New South Terminal Station in Boston (Digest, Nov. 25). The switch mechanisms are described and illustrated.—*Railr. Gaz.*, Dec. 1.

Cable Ship Podbielski.—A reprint of the article noticed in the Digest Dec. 16.—*Elec. Rev.*, Dec. 6.

MISCELLANEOUS.

REFERENCES.

Electric Fatality.—A note stating that a young man was recently killed in an English plant by an electric shock, although the highest voltage he could have received was only 225. His wet boots and freely perspiring body led to his being in a favorable condition for a severe shock.—Lond. *Elec. Rev.*, Dec. 1.

Physiological Effects of the Current.—PREVOST and BATTELLI.—A long abstract of their French Academy paper noticed in the Digest Dec. 2.—*West. Elec.*, Dec. 9.

Production of High Temperatures.—GOLDSCHMIDT.—A very long French abstract of his German Electrochemical Society paper, noticed in the Digest Aug. 26.—*L'Eclairage Elec.*, Nov. 18.

Berlin General Electric Co.—A long abstract of the last annual report of this prominent German company.—*Elek. Zeit.*, Nov. 23.

Bunsen.—E. L. N.—An account of the life and work of the late Prof. Bunsen, including a good portrait.—*Phys. Rev.*, November, December.

Joseph Henry.—REYNOLDS.—An interesting and well illustrated account of his life and work.—*Sc. Amer.*, Dec. 23.

New Book.

MONOPOLIES AND THE PEOPLE. By Charles Whiting Baker, C. E. Third Edition, Revised and Enlarged. New York: G. P. Putnam's Sons. 368 pages. Price, $1.50.

We are glad to note that Mr. Baker's book has got into its third edition. Not because we agree with him in the views he sets forth. On the contrary, his main line of argument, his facts, his deductions, challenge a desire for contradiction in us at wellnigh every page. But an honest and sincere effort to advance a belief or a theory is always to be welcomed, and as no question is ever settled until it is settled right, every controversial treatment of this kind is one more step toward the solution of one of the greatest questions of our time, namely, to what extent we shall delegate to government the ownership of industries. In regard to this question Mr. Baker has been and remains an expansionist, and he would have governments "assume responsibilities that were undreamed of a year ago," on the ground that there is no alternative now that "the era of free competition is passing away." If we catch Mr. Baker's meaning aright, he would prefer to see his own excellent journal suppressed as a private enterprise and carried on by a government bureau. Perhaps that is a side issue, but we must confess again that we do not follow Mr. Baker when he asserts that practically all industries are being monopolized when at the same time he comments upon the fact that the wide, wide public has bought eagerly into the ownership of such securities amounting to four billions of dollars. We may be obtuse, but this strikes us as a curiously sure sign not that industries have been monoplized but that it has been rendered possible for everybody to own a proprietary interest in every one of them—a thing our fathers could not do, because the concentration of effort and capital had not gone far enough. It seems to us that the world goes forward in civilization on just these lines, that they are strictly evolutional, while the reversion to governmental monopoly would be disastrous. So far from finding it necessary to turn over all the industries to the government because a good deal of merging has gone on, the only remedy required at the present time, it seems to us, is an improvement in some of the rules of the stock exchange, and a little less meddling by the government with the individual initiative, which, while it is working in some directions towards economic solidarity, is working in just as many others toward new heterogeneity of opportunity and occupation. What we started in to say, however, was that Mr. Baker's book is timely and worth reading whether you agree with him or whether you don't.

Directory of Electric Societies, Etc.

CHICAGO ELECTRICAL ASSOCIATION, Chicago. Next meeting Jan. 5, 1900. Paper: "Modern Construction of Dynamo Electrical Machinery," by H. R. King.

NORTHWESTERN ELECTRICAL ASSOCIATION. Next meeting Milwaukee, Wis., Jan. 17, 1900.

Federal Salts in Open Circuit Batteries Compared with Sal Ammoniac.

BY FRED'K C. OVERBURY.

The action which takes place in a carbon battery using sal ammoniac as an excitant, differs entirely from that of "Federal Salt" or "Federalite" under the same conditions.

When the circuit is closed in a cell containing sal ammoniac, the ammonium is released and an insoluble oxychloride of zinc is formed. As a result of this the internal resistance of the electrolyte increases rapidly, and as the hard oxychloride crystals form on the carbon and zinc, the active surface is gradually lessened and the efficiency of the cell is impaired.

With the above-mentioned compounds used as the electrolyte the action on closed circuit is to form a soluble sulphate of zinc which is a better conductor than the original electrolyte. As there is no insoluble matter formed, the pores of the carbon are always open, and the entire active surface is presented to the zinc. The

FIGS. 1 AND 2.—CARBON CYLINDERS TAKEN FROM SAL AMMONIAC AND FEDERAL SALT SOLUTIONS.

closing of the circuit releases enough acid to act on the depolarizer present in the compound, thus preventing polarization and aiding the battery to recuperate quickly.

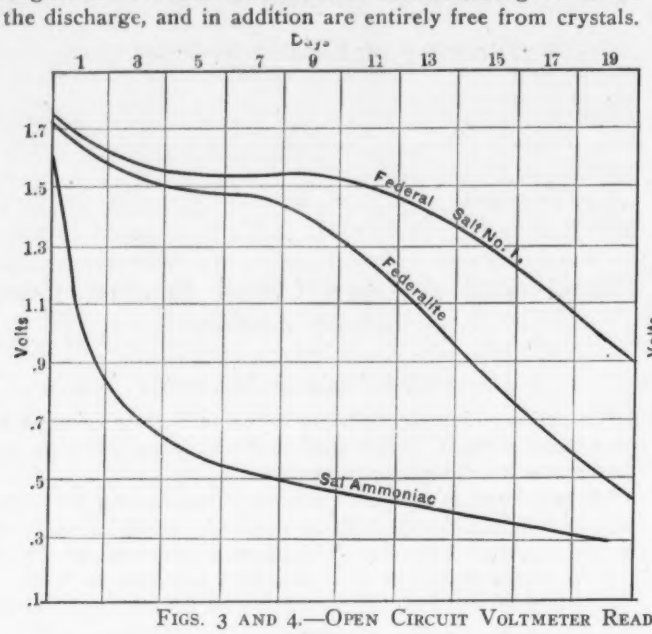
Figs. 1 and 2 show the carbons used in a recent test, one from a sal ammoniac solution all covered with crystals, and another from a "Federal salt" solution, showing the carbon perfectly clean. Both were used in tests exactly alike and under similar conditions. For purposes of comparison, curves are given of these tests.

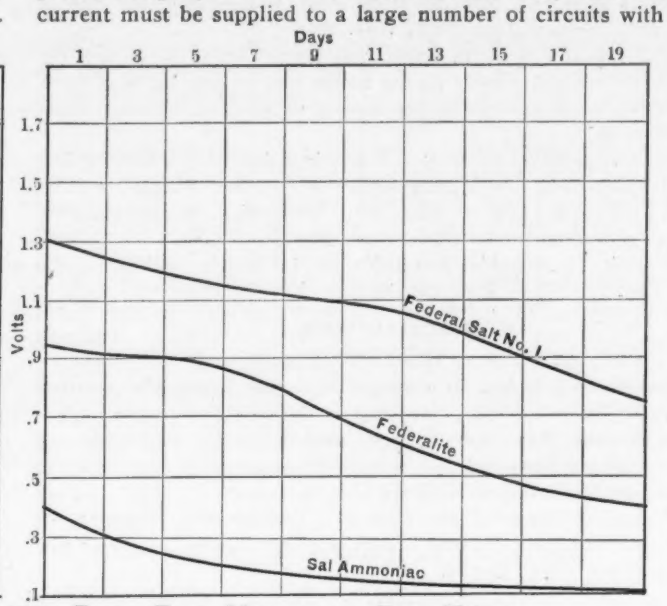
Three batteries, one containing "Federal salts," one "Federalite" and one sal ammoniac, were connected in series on a 20-ohm telegraph instrument, and kept on closed circuit for seven hours each day for nineteen consecutive days.

The voltmeter readings are plotted in Figs. 3 to 6. Those of Fig. 3 show open circuit voltmeter readings taken every morning for nineteen days; Fig. 4 are curves of open circuit readings each night after seven hours' work. The curves of Fig. 5 are from closed circuit readings each morning, and those of Fig. 6 closed circuit read-

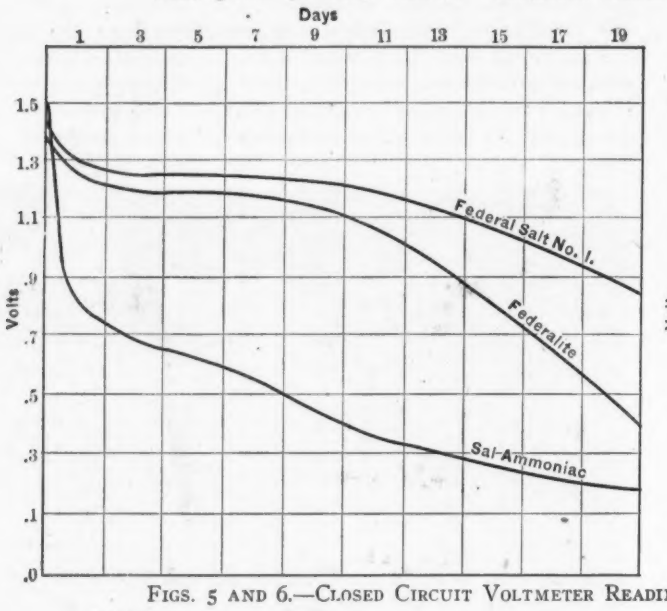
ings each night after seven hours' work. The ampere readings of Fig. 7 were taken each morning for the nineteen days, and those of Fig. 8 are from ampere readings each night.

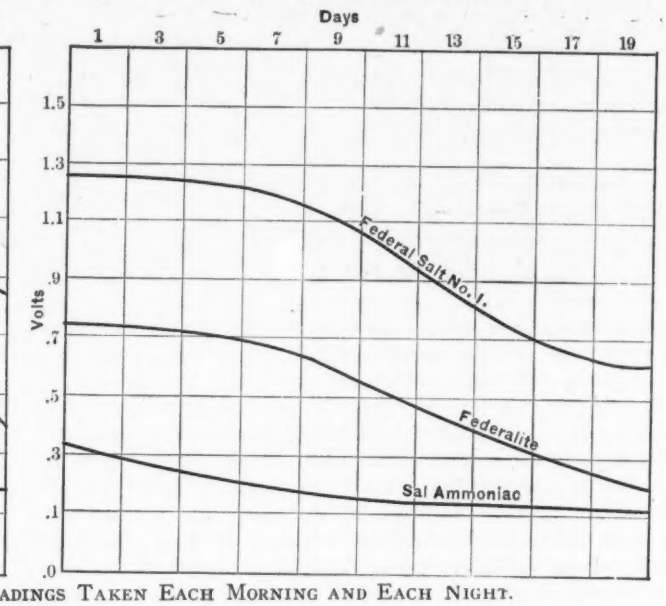
It can be readily seen from the above charts that the compounds give a higher e. m. f. and more constant current during the entire life of the discharge, and in addition are entirely free from crystals.



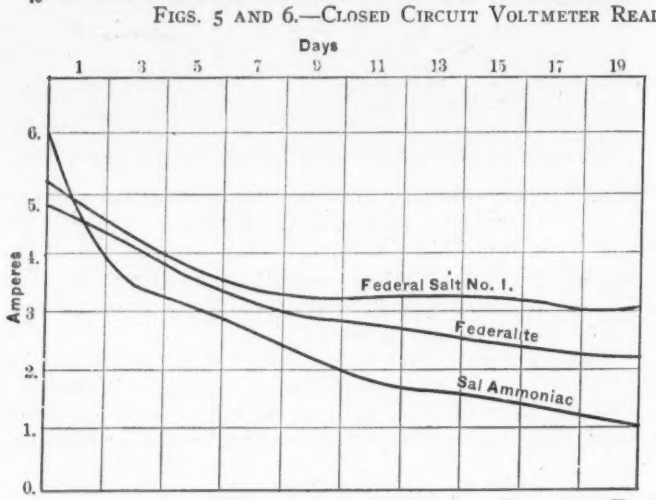


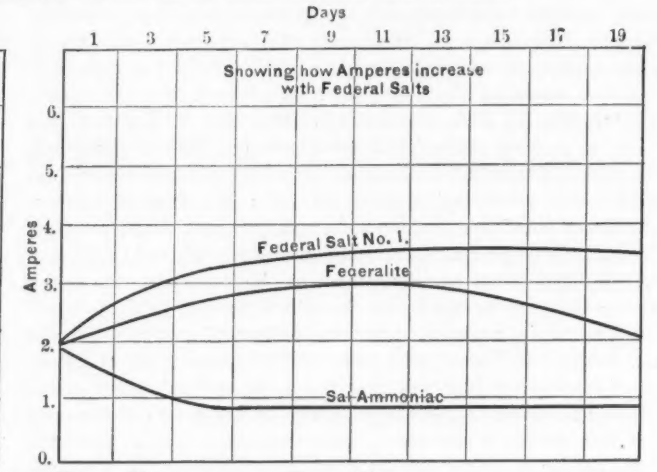
FIGS. 3 AND 4.—OPEN CIRCUIT VOLTMETER READINGS TAKEN EACH MORNING AND EACH NIGHT.





FIGS. 5 AND 6.—CLOSED CIRCUIT VOLTMETER READINGS TAKEN EACH MORNING AND EACH NIGHT.





FIGS. 7 AND 8.—AMPERE READINGS TAKEN EACH MORNING AND EACH NIGHT.

While the amperes of the sal ammoniac cell would appear to be higher at the start, it can be seen that under work both the "Federal salt" and "Federalite" are more constant, and, in fact, the amperes increase as the zinc salt is formed. For hard work, such as gas engine, gas lighting or for telephone, the compounds maintain a constant current where sal ammoniac would soon become inefficient.

A Large Rushmore Multi-Voltage Plant.

While large power stations usually supply the bulk of their output at a single voltage, with perhaps a few boosters to raise the pressure slightly on a few feeders, there are many cases where the current must be supplied to a large number of circuits with widely varying pressures. Such a case is in the large electrolytic copper refining works of the Nicholas Chemical Company, at Greenpoint, N. Y. Until the present year this company's plant consisted of some fourteen separate generating sets of about 100-hp each, the sets supplying current to a series of copper vats, which require a constant current of about 400 amperes, with voltage varying from 100 to 200 volts. Owing to increased business, the company decided

last year to install 1600-hp additional capacity in generators. It was asserted that they would be obliged to put in either sixteen additional generators or one or more large constant potential generators with sixteen boosters to give the necessary voltage regulation on the different series of vats.

The matter came to the attention of Mr. S. W. Rushmore, of the Rushmore Dynamo Works, Jersey City, and he promptly recommended his multi-voltage system, on the ground that it would enable the use of large generators with all the advantages of voltage control to be had with the small units, and with all the saving in first cost and in efficiency common to large units. Although Mr. Rushmore had considerable difficulty in convincing the various makers who were asked to bid to his specifications, that the machines would work at all, the contract was finally placed with the Westinghouse Electric & Manufacturing Company for four 275-kw generators, direct-coupled to Herreshoff triple-expansion condensing engines. These machines have each eight poles, and four pairs of brushes. Each pair of brushes is connected to a separate series of vats and each pair of poles is wound for separate excitation from the pair of brushes adjacent thereto, with a separate field rheostat in each field circuit. Thus the machines are to all intents four separate units built into a single machine. The armatures are common multi-path drum type.

The rheostats are so arranged that the voltage of each pair of brushes may be controlled independently from 0 to 200 volts, or all the rheostat handles may be locked together, and thus all brushes will be kept at the same potential and the machine may be operated as a common single voltage unit on a single circuit.

Each pair of brushes supplies 400 amperes at from 0 to 200 volts, and it frequently happens that one or more of the circuits may be idle and one or more pairs of the brushes will be supplying full load and voltage while others are perfectly dead. In this manner the machines may be shut down in sections, and there is a considerable saving in power for field excitation, iron losses, etc., when not fully loaded.

It has been found that there is not the slightest interference between the different circuits, no matter how they differ in load or voltage. These machines have now been in service for 24 hours a day, and every day, without shutdown for over a year, and they have shown a very large saving in first cost, real estate, and in coal consumed, and the owners express themselves as highly pleased with the performance.

The multi-voltage system was fully described in the ELECTRICAL WORLD of Feb. 5, 1898. The Rushmore Dynamo Works are also building large multi-circuit arc dynamos, and now having regular service machines supplying two independent circuits of 150 lights each. They also have under way a 500-light five-circuit direct-connected arc machine for enclosed lamps.

The Rushmore Works are not building the multi-voltage machines, as the system may be applied with any make of constant potential machine with very slight increase in cost, and they are therefore acting merely as engineers where the system is employed for electrolytic, storage battery and elevator service, feeder and main systems, etc. The system does away entirely with boosters and resistances.

Vehicles of the General Electric Automobile Company.

One of the most attractive and important exhibits made at the National Export Exposition in Philadelphia was that of the General Electric Automobile Company of that city, which showed one of its vehicles. A good idea of the character of these vehicles may be obtained from the accompanying illustration. Lightness in appearance and simplicity of construction are marked features, this being accounted for largely by the small battery space required. Double motors are used, each being attached to an internal gearing on each hind wheel. Both motors are spring-suspended on one side, from two reaches connecting the front and rear axles independent of the carriage body, and the other side of the motors are hung directly on the axles.

FIG. 1.—ELECTRIC SURREY.

The wooden wheels (33 and 38 inches respectively in diameter), with solid rubber tires, are most frequently used on these vehicles. The company is making a specialty of delivery wagons and electric runabouts (with dos-a-dos seats). The vehicles cover a distance of from 25 to 35 miles, according to grades and conditions of roads, at an average speed of 12 miles per hour, with a maximum speed of about 18 miles per hour.

FIG. 2.—REPRESENTATIVE TYPES OF ELECTRIC VEHICLES.

The surrey, which is also shown in a separate cut, weighs only 1910 pounds, which is quite light when it is considered that the vehicle has capacity for carrying four people. The batteries are admirably concealed under the two seats, so that the crates require no unsightly or conspicuous battery space. The absence of this usual provision, which renders so many vehicles clumsy and ugly, accounts for the graceful appearance and stylish lines of the vehicle.

NEWS OF THE WEEK.

Financial Intelligence.

THE WEEK IN WALL STREET was a rather agonizing performance for a great many people who saw suddenly taken out of their Christmas stockings the handsome profits that months of booming prices had put there, but fortunately Saturday wound up with a rally begetful of feelings more appropriate to this festive season of the year. The height of prices is by no means what it was, and is certain not to touch the old level until England has cause for throwing off her blues and sees a chance of the near resumption of gold supplies from the South African mines. But there was danger of a serious nature to finance and industry alike in the rage for speculation, and there is some reason to believe that if the profits of 1900 may not look as big as those of 1899, they may in reality be much more solid and enduring. During the week no fewer than 5,155,992 shares of stock were sold, as compared with 3,833,771 in the same week last year, figures which give a vivid idea of the activity of the market. On sales of 11,430 shares, Western Union was off to 84½, a decline of 1¾. General Electric, on 10,805 shares, closed at 118, a decline of 1. On sales of 88,837 shares, Metropolitan Street Railway closed at 157, a decline of 10, and Manhattan Elevated was off to 89⅝, a decline of 6⅝, on 140,642 shares. Brooklyn Rapid Transit was also badly cut up, and on dealings in 512,036 shares, declined 9⅝ to 67⅞. In Boston, American Bell Telephone closed at 341; Erie, 101; New England, 138; Michigan, 101; Mexican, 2½; Boston Elevated, 98; West End, 91¾ common, 112 preferred. In Chicago, Union Traction preferred closed at 74-74¾; West Chicago Railway, 110½; Metropolitan Elevated certificates 23 and 5s, at 92⅞-93. In Philadelphia, Electric Storage Battery closed at 75-76 common, 65-65½ preferred; Penn. Elec. Vehicle Co., 7-7½ common, 4-4⅛ preferred; Philadelphia Traction, 94-94½; Union Traction, 35⅛; Elec. Co. of Am., 11½; Consol. Traction, N. J., 60¼. In the New York outside market, Elec. Axle Light & Power Co. closed at 5½-6; Elec. Boat, 20-25 common, 35-45 preferred; Elec. Vehicle, 43-48 common, 75 preferred; N. Y. Transportation, 9-10; Illinois, 2¼-2¾; Gen. Elec. Automobile, 9-10; Otis Elevator, 18-20 common, 85-88 preferred.

CHICAGO TRACTION PROPERTIES.—The first legal step toward uniting the property of the Chicago Consolidated Traction Company with the property of the Chicago Union Traction Company was taken last week when a circular was sent to all stockholders of the former company announcing the terms on which the change of control would be effected. The circular notified the stockholders that they could turn in their stock and receive in exchange the bonds of the Chicago Consolidated Traction Company, guaranteed by the Chicago Union Traction Company. The Chicago Consolidated Traction properties are located in the north and northwestern parts of the city and suburbs. The lines were built under the Yerkes management as feeders for the North Chicago Street Railroad Company and the West Chicago Street Company, and Mr. Yerkes retained control of them when he sold out his other surface interests to the Chicago Union Traction Company.

AMERICAN ELECTRIC VEHICLE CO.—A special despatch from Chicago of December 26 says: The headquarters of the American Electric Vehicle Co., according to an announcement made to-day, will be removed to New York City on January 1. The offices and factory here will be vacated, and the company will establish itself in a large plant in New Jersey, near New York, the factory to have a capacity of five vehicles a day. "Our reasons for moving to the east are many," said C. E. Corrigan, vice-president of the company. "New York is now the natural automobile center of the country, though Chicago has heretofore held most of the trade. It is hard to sell automobiles here and get good prices for them. New York has a thousand wealthy men where Chicago has one. We can do more business if we are at the center of wealth. Automobile men in the east are, furthermore, more active than those of the west."

DIVIDENDS.—The General Electric Company has declared a regular semi-annual dividend of $3.50 on preferred stock, payable January 31, and a regular quarterly dividend of 1½ per cent. on the common stock, payable January 15. The New London Street Railway Company has declared a semi-annual dividend of 2 per cent., payable January 1. The Norwich Street Railway Company has declared a semi-annual dividend of 1 per cent., payable January 1. The New York Metropolitan Street Railway has declared a regular quarterly dividend of 1¾ per cent., payable January 15. The National Carbon Company has declared a quarterly dividend of 1¾ per cent. on preferred stock, payable January 15.

ROCKY MOUNTAIN BELL.—The Rocky Mountain Bell Telephone Company will increase its capital stock from $1,000,000 to $2,000,000. It operates under the Bell patents in Utah, Wyoming and Montana, and it is proposed to connect the entire system with Denver, Cheyenne and points in Idaho as far as the Pacific Coast Company's lines, there connecting with that system into all points of Washington, Oregon and California. President George Y. Wallace has been in Boston in conference with the Bell Telephone officials on the subject.

CONSOLIDATION AT SEATTLE.—A consolidation of all the electric railroads and electric light plants in Seattle is in progress, and the promoters state that they have already sufficient capital to float the scheme. Options have been secured on all the trolley lines in the city, as well as on the lighting plants.

B. R. T.—One of the stocks hit hardest during the recent Wall street panic was Brooklyn Rapid Transit, and it is said to have been made the subject of a special drive by the bears. The company has offered a reward of $25,000 for the exposure of those who conspired against it in the stock market, and the matter has been taken before the grand jury.

BELL TELEPHONE DIVIDEND.—The directors of the American Bell Telephone Company have declared a regular quarterly dividend of 3 per cent, and 1½ per cent. extra, payable January 15. The delay in the announcement of the Bell Telephone removal plans is due to the disturbance in the financial markets.

DIVIDENDS.—The Otis Elevator Company has declared a quarterly dividend of 1½ per cent. on its preferred stock, payable January 15. The Westinghouse Electric & Manufacturing Company has declared a quarterly dividend of 1¾ per cent. on its preferred stock, payable January 2.

BOSTON ELEVATED.—The directors of the Boston Elevated have voted to call $25 per share February 16, 1900, and $25 per share April 16, 1900, which will complete the entire payment on the stock, or $100 per share.

CENTRAL AND SOUTH AMERICAN TELEGRAPH CO. has declared a regular quarterly dividend of 1½ per cent., payable January 8, with an increase of surplus from $508,734 to $552,448.

Commercial Intelligence.

THE WEEK IN TRADE was in every respect a good one, and Christmas business was by all accounts about as large as it could be. While the stock market felt the pinch of dear money, industries into which so much of that money had gone did not feel any special cause for worry on that account, and, in fact, the reports from every line are encouraging. Discussing this curious situation, of a semi-panic in the very midst of universal prosperity, Dun's says: The worst day in Wall street for years was in part the legitimate result of the best year in business ever known. Because the country had prospered so greatly and had so expanded its business, it could no longer afford to have many millions locked up in carrying stocks representing imaginary values. The question was not one of momentary supply. When the country found ample use for its capital in regular trade and productive industry, a contraction of loans became necessary, which would only have been more painful if the volume of stocks carried had been larger. Reckoning from the highest general average last spring, industrial stocks had fallen at the close on Monday 23.27 per cent., street railroad stocks 38.90 per cent., and other railroad and telegraph stocks only 6.70 per cent. Extreme monetary pressure was quickly relieved by a syndicate of banks, the Treasury aiding much, and prices soon recovered a part of their loss, only to decline later again. On the same general subject, Bradstreet's says: Holiday trade activity, of course, reaches its highest development during the week now drawing to a close, and it is significant of the prosperous conditions underlying the general business situation that reports almost without exception point to a volume of business having few, if any, parallels in previous years. Another significant feature developed also is that the demand for such goods embraces a higher class and a more expensive grade of materials, a conclusion among trade reporters being that a larger buying capacity exists now than in any pervious year in the country's history. This favorable condition, too, exists in face of the fact that weather conditions have not altogether favored retail distribution of winter goods, the result being less activity in purely retail lines than had been looked for, though comparisons with one year ago are generally favorable. Wholesale trade at this season usually shows a quieting tendency, but it is questionable whether this tendency is as marked this year as in former periods. To the advanced stage of the season chiefly, and perhaps also to the sentimental effect growing out of stringent money conditions in speculative lines, may be charged some of the quietness noted. As above intimated, however, this is less marked than in ordinary years. Failures in two weeks of December were $4,422,056, against $9,172,638 last year, $7,227,303 in 1897, and $14,602,007 in 1896. Manufacturing were $1,077,984, against $3,672,709

last year, and trading were $2,447,150, against $5,016,598 last year. Failures for the week were 220 in the United States, against 258 last year, and 26 in Canada, against 31 last year.

GENERAL ELECTRIC'S YEAR.—The output of the General Electric Company is understood to reach the magnificent total of $25,000,000. Discussing its business and the outlook, Mr. S. Dana Greene, the general sales manager of the company, says: "We are glad to be able to say that our business has shown a very material increase over last year. This is due partly to the increased prices which have been made necessary on account of the abnormal advances in the price of raw materials, amounting on some important items, such as sheet iron, to about 100 per cent. advance. While there seems to be no evidence at the present time that prices of raw material will show any marked decline during the coming year, we believe, nevertheless, that raw material costs (and therefore prices) have reached the high-water mark. Local companies are paying more and more attention to economies of operation, both inside and outside of their stations, and to intelligent methods of charging customers for current consumed, with the result that there have been many plants during the past year which have thrown out old and obsolete apparatus and supplies and installed modern appliances in their place. There has been, as you are undoubtedly aware, a very marked advance made in the general introduction of enclosed arc lamps, both for commercial and street lighting purposes on alternating and direct currents, and this progress bids fair to be equally advanced during the coming year. Apart from the constantly increased sizes of machines, there have been no radical changes during the past year in methods or systems of installation and distribution. In electric railroad work the tendency toward larger and heavier cars and higher speeds (with correspondingly larger and more powerful motors) is very marked, and many steam roads are now giving serious attention to the problems of the electrical equipment of branch lines. It is an interesting fact that in such installations the electrical apparatus forms about 20 per cent. only of the total cost of equipment. In fact, this percentage is true for any large central station, the land, buildings, boilers, engines, etc., outside of electrical machinery, amounting to about 80 per cent. of the entire expenses."

NEW BUILDINGS.—The year has closed in Greater New York with a tremendous rush of real estate development, carrying with it the promise of a large amount of electrical work. The total of the plans filed for 1899 has run over $150,000,000, and much of it has come at the close. The banking district is to have a $4,000,000 building on Exchange place and Beaver street, put up by the Alliance Realty Company. No fewer than twelve elevators are to go in, and it will have thousands of electric lights. Uptown, the Union Club has secured property at Fifty-first street and Fifth avenue for a splendid new house, and Colonel John Jacob Astor is to build a fifteen-story hotel at Fifty-fifth. At Sixth avenue Adams & Co. are to put up a huge new building on Twenty-first and Twenty-second streets. It will have six electric elevators and a large steam and electric plant in the basement. A large number of six-story apartment houses have been planned, in practically all of which provision is made for electric light and power.

WORK AT BROOKLYN NAVY YARD.—Captain P. C. Asserson, civil engineer of the Brooklyn navy yard, has prepared plans which have met the approval of the Secretary of the Navy for an underground electric pumping station for drydock No. 1, costing about $40,000. The station will be underground in order to save space in the navy yard, which every year is getting more valuable. It will be located at the head of stone drydock No. 1, and will replace the old and antiquated station which was built in 1854. Centrifugal pumps, operated by electricity and having a capacity of throwing 30,000 gallons of water out of the drydock a minute, will be installed, and 350-hp of electric motors will be used to operate the pumps. When the new plant is completed the dock can be emptied in one-third of the time now required and at one-half the cost. It will take five months to build the new pumping station. The funds for its construction will have to be furnished by Congress. Stone drydock No. 1 is among the best owned by the United States Government. It cost $2,000,000, and required ten years to build.

AUTOMOBILE COMPANY OF AMERICA has secured the ill-fated old shops at Marion N. J., once occupied by the historic Daft Electric Company, which once bid fair to cut a big swath in electrical power development in America. The Automobile Company of America, whose offices are located at 32 Broadway, are purchasing a fair-sized equipment for the shop. With this company are identified the American Motor Company. The two concerns occupy the same New York offices. The motors of one company will be used in the vehicles of the other. The factory has for the last seven years been vacant. The new occupants are now having the place put in shape. It is to be hoped they will "lift the hoodoo."

LUNDELL MOTORS IN JAPAN.—A large order has just been received by the Sprague Electric Company, of New York, for sixteen motors to be used in running the presses and machinery in a lithographing establishment in Tokio, Japan. It will be one of the finest equipped plants in Japan, and will be operated under the supervision of a Japanese expert, who is now in this country gathering ideas. The selection of the Lundell motors demonstrates the ability of the Japanese to recognize the importance of electrically-operated machinery. The Lundell motors have been most thoroughly tried on a variety of similar work in this country, and in such big plants as that of the American Lithograph Company in New York City.

MR. ROBERT T. LOZIER, of the Bullock Electric Manufacturing Company, has just returned from a trip to England, and reports the business outlook as excellent, so far as the export of American electrical apparatus is concerned. He did not go over expressly for business reasons, but to take a brief rest. This did not prevent him, however, from looking into things that came his way, and one order which he brought back with him runs into a good many tens of thousands of dollars. Mr. Lozier's associates are glad to see him back, but under the circumstances think another trip for his health in order.

A PLANT FOR LONG ISLAND.—The Standard Electric Light, Heat, Power & Manufacturing Company, which has just been established at Manhasset, Long Island, intends to lose no time in getting down to business, and Mr. John W. Mitchell, secretary of the company, informs us that it is now in the market for about ten miles of line wire, 200-hp of engine and boiler, and dynamo capacity for 2000 lights. It will also entertain bids for the construction of its plant. Mr. M. G. Wanzor is the president of the company, which starts out with a capital stock of $25,000.

ICE MACHINERY.—The Sumter Electric Light & Ice Company, of Sumter, S. C., has recently organized for the purpose of erecting electric light and ice plants. The contract for the ice-making machinery has been awarded to the York Manufacturing Company, York, Pa. The plant will be on the can system, and will have a capacity of 25 tons per day. The York Manufacturing Company have sold through the American Trading Company, of New York, one of their latest improved six-ton can ice-making plants, which will be shipped for erection in Kobe, Japan.

AKRON ELECTRICAL MANUFACTURING CO., of Akron, O., has been reorganized and the following officers elected: President, L. C. Miles; vice-president, Will Christy; general manager, E. E. Andrews. The object of the reorganization has been to increase the old company's facilities and assume in addition the business of the American Electric Tool Company, consisting of two excellent specialties, namely, the Packard recording wattmeter and the Bosworth commutator truing device.

INDICATORS FOR EXPORT.—It strikes one as being rather singular that while South Africa and the Philippine Islands are in a state of war, orders for indicators should come from both places. Jas. L. Robertson & Sons, 203 Fulton Street, New York, inform us they have just received such orders, and in addition to the last named they are shipping six steel indicators for one of the largest government refrigerating plants in our new possessions.

ORDER FOR CAR BARN.—The new car barn at Port Chester, Conn., for the Port Chester Street Railway Company, will be furnished by the Berlin Iron Bridge Company, of East Berlin, Conn. The building will be one of the largest of its kind in the country. The Berlin people also have an order from the Clyde Steamship Company for a new pier shed and dock at Providence, R. I., the building to be 40 feet wide and 600 feet long.

ELECTRICAL FIRE ENGINES.—The Electric Fire Engine Company of America was organized in Des Moines, Ia., recently. The authorized capital stock of the new corporation was fixed at $50,000, and the principal nature of the business to be transacted is the manufacture and sale of electrical fire engines. The incorporators are Theodore John, Webb Bishop, John Carmody and C. A. Blomgren, all of Des Moines.

THE JOHN H. McGOWAN CO., of Cincinnati, O., well known builders of pumping machinery, are opening warerooms and offices in Philadelphia with Mr. Fred E. Doran as resident manager. His extensive experience in this line of machinery will enable him to promote the interests of the McGowan Co. in that territory. Their line embraces latest designs of pumps of single, duplex and flywheel type.

TROLLEYS IN FRANCE.—Consul Milner, of Calais, under date of October 30, 1899, informs the department that a company organized at Paris is arranging to establish an electric railway in Calais. The equipment has not yet been purchased, and the consul thinks that United States manufacturers may wish to bid. The old cars now in use are of American make.

ELECTRICITY ON STEAM ROADS.—Chairman Charles P. Clark, of the New Haven Board, says: "The time is not far distant when the suburban business in New England States will be done by electricity. The time will come when it will generally supplant steam."

STANLEY APPARATUS.—The New Albany Light, Heat & Power Company, of New Albany, Ind., has recently purchased from the Western Electric Company a 200-kw two-phase Stanley generator, and is increasing the capacity of its plant.

Special Correspondence.

NEW YORK NOTES.

New York, Dec. 26, 1899.

MR. M. HARRIS, of the Manhattan General Construction Company, Newark, N. J., has left on a four weeks' business trip throughout the western states, in the interests of the Manhattan lamp, which is meeting with great success this season.

TROLLEY CARS ON TENTH AVENUE.—The new trolley cars of the Third Avenue system began running on Dec. 22 along Tenth Avenue from Fiftieth Street to Seventy-ninth Street. This completes the electric line as far down as Fifty-ninth Street, where passengers are transferred to the Forty-second Street line.

MR. A. L. KASSON, president of the Northwest Fixture Company, of Seattle, Wash., informs us that they have opened an eastern office at Room 921, Havemeyer Building, for the purpose of purchasing goods for the various lines that they represent in the west. It will be in charge of Mr. C. J. Purdy as purchasing agent.

NEW POWER HOUSE AT ROCKAWAY PARK.—Ground will soon be broken for the erection of a power house at Rockaway Park. The building will be erected by the Long Island Railroad Company within its yard limits and will contain the necessary machinery to operate its electric road between Rockaway Park and Far Rockaway.

NEW METROPOLITAN CAR HOUSE.—Plans have been submitted by the Metropolitan Street Railway Company for a four-story brick carhouse, to cost $350,000. The building is designed to replace the present car stables at Fifty-fourth Street, corner of Ninth Avenue. It will front 135.10 feet on the avenue, 525 feet on Fifty-fourth Street, extending 200.3 feet to Fifty-third Street, on which street it will front 115 feet.

SUPERSTITIOUS AUTOMOBILISTS.—The number 13 has terrors as well for the intelligent automobilist as for the most ignorant person that walks the streets. Park Commissioner Clausen has been issuing permits to run automobiles in Central Park with great care and misgiving. The number of fortunates had reached 12, with more in waiting. It is said that the 13th number fell to a Wall Street man, but he had an inborn dislike for the number, so he got No. 14. Another gentleman took the "unlucky" number.

THE RAPID TRANSIT PROBLEM.—Comptroller Coler on Dec. 23 sent a letter to Alexander E. Orr, president of the Rapid Transit Commission, asking him to call a special meeting of the commissioners for the purpose of deciding whether they have power to extend the underground railway to all the boroughs of the city. Commissioner George L. Rives and W. Barclay Parsons, chief engineer of the commission, believe that it has power, under the act creating it, to dig tunnels wherever it thinks wise and proper in Greater New York.

ELECTRIC PUMPING IN THE BROOKLYN NAVY YARD.—An underground electric pumping station is proposed for dry dock No. 1 at the Brooklyn Navy Yard. It will cost about $40,000 and will be placed underground in order to save space. Centrifugal pumps, operated by electricity and having a capacity of throwing 30,000 gallons of water out of the dry dock a minute, will be installed, and 350-hp electric motors will be used to operate the pumps. When the new plant is completed the dock can be emptied in one-third of the time now required and at one-half the cost. It will take five months to build the new pumping station.

ALLEGED SMOKE NUISANCE.—Mr. H. W. York, chief engineer of the United States Electric Light & Power Company, of this city, was arrested on Dec. 22, on a complaint of an inspector of the Board of Health that Mr. York permitted the use of soft coal in the furnaces at the East Twenty-eighth Street station. Counsel for the company stated that it had fully complied with the law and had recently adopted a device for the consumption of the smoke. It was now in operation, and if the inspector would visit the premises again he could satisfy himself that there was no cause for complaint. The examination was postponed until Jan. 5, pending a public investigation.

FREIGHT TROLLEY CARS IN BROOKLYN.—Plans are again on foot in Brooklyn looking toward the carrying of freight about the city on trolley cars, the cars to be run during the night. Within two weeks overtures have been made to President Rossiter, of the Rapid Transit Company, for the use of his lines for the running of the cars. Beyond this preliminary stage, however, matters have not advanced. It is understood that the National Express Company and allied interests are behind the present plan. The National Express Company already runs trolley express cars through Brooklyn streets, and, it is understood, is anxious to develop the business much further.

PARSELL & WEED is the name of a new concern which is opening up business at what it has called the "Franklin Model Shop," 129-131 West Thirty-first Street, this city. It has an excellent equipment for model-making, electrical testing and designing, and all classes of experimental work, such as that which is often necessary in working out inventions or in perfecting goods for the market. The members of the firm are well known, Mr. H. V. A. Parsell, Jr., having a wide acquaintance in the electrical field. His associate, Mr. A. J. Weed, M. E., has made a specialty of small gas engines, and the two men are now working on a book on gas engine construction which Norman W. Henley & Co. are to bring out. The firm invite correspondence and inquiries of all kinds.

FALSE RUMORS ABOUT BROOKLYN RAPID TRANSIT.—Last week false reports were spread in Wall Street regarding the condition of the Brooklyn Rapid Transit Company, even to the extent that a receivership for the company was imminent. These reports, it is stated, were utilized in Wall Street to depress this company's stock. The directors of the Brooklyn Rapid Transit Company, however, do not propose to let the matter pass without a vigorous protest against such methods. They held a meeting last Friday and passed a resolution offering a reward of $25,000 for information furnished to the counsel of the company that will lead to the discovery and conviction of any of the persons who have circulated these false and malicious reports. The circulation of false statements or rumors with the intent to affect the market price of the stocks or securities of a corporation is punishable criminally under the laws of this state.

THE BROOKLYN RAPID TRANSIT COMPANY has issued a formal notice to its employees that dating from Jan. 1 their wages will be increased from 5 to 15 per cent. All employees who have been continuously in the service of the company for two years are to receive $2.10 a day. Those who have served for three years, $2.20, and five years or more, $2.30 a day. The increase in wages, it is said, is made in pursuance of the company's desire to recognize faithful and continuance service. It is hoped that it will have the effect not only of creating an additional interest on the part of the men in the welfare of the company, but that it will attract to the company faithful and competent men who may be able to look forward to increasing compensation with increasing tenure of employment. A high standard of duty will be expected, and the company's desire is to have on its payroll only such men as are qualified by intelligence, industry and loyalty to discharge properly their duties.

THE AUTOMOBILE SHOW.—Applications for space at the Cycle and Automobile Exhibition, which will be held in Madison Square Garden during the week following Jan. 20, 1900, are rapidly coming in. The following named automobile companies will be represented by exhibits: Indiana Bicycle Co., Loomis Automobile Company, International Automobile & Vehicle Tire Company, Foster & Co., Canada Manufacturing Company, Riker Electric Vehicle Company, Duryea Motor Company and the Locomobile Company of America. Among manufacturers and dealers in accessories, the following will be represented: Automatic Tire Inflator Company, Frederick Manufacturing Company, Kelly Handle Bar Company, J. G. Mooney, D. B. Smith & Co., Electro Lamp Co., W. H. Fauber, Frank Mossberg Company, Frank E. Bundy Lamp & Sundry Company, Rose Manufacturing Company, William P. Miller's Sons, Peter A. Frasse & Co., Empire Rubber Manufacturing Company, American-Dunlop Tire Company, B. F. Goodrich & Co., Straus Tire Company, National India Rubber Company, Diamond Rubber Company, Jos. Dixon Crucible Company, Veeder Manufacturing Co., G. W. Cole & Co., Gleason-Peters Air Pump Company, Manhattan Brass Company, E. A. Brecher & Co., Badger Brass Company, C. J. Smith Sons & Co., George L. Thompson Company, Cleveland Ball & Pedal Company, Indianapolis Chain & Stamping Company, Spinroller Company, American Roller Bearing Company, and the 20th Century Manufacturing Company. Every bicycle maker of note is included in the list of firms that will exhibit at the show. In addition to all the prominent makers now with the American Bicycle Company, the independent makers have decided to show their goods.

NEW ENGLAND NOTES.

Boston, Mass., Dec. 23, 1899.

THE AMERICAN ENDOSCOPIC COMPANY, Providence, R. I., has issued a neat little calendar for 1900. This company, as is well known, carries on a business of manufacturing and dealing in electrically-lighted surgical instruments and attachments and high-grade miniature and decorative lamps.

THE TELEGRAPHERS' UNION.—The grand jury of the United States Circuit Court has indicted A. L. Ackley, superintendent of the Taunton division of the New York, New Haven & Hartford; also Hugh J. Hill, train despatcher in the same division, for being instrumental in the discharge of P. A. Galligan, a member of the Telegraphers' Order employed in the train despatchers' office. It was alleged that Galligan was threatened with discharge for being a member of the Order, and was finally discharged. The indictments are the first of the kind returned in this state and raised many legal questions. The action was taken under Section 10, of the Interstate Commerce law.

STREET RAILWAY CONSOLIDATION.—The Railroad Commissioners have given hearings on petition for the consolidation of ten roads in the Massachusetts electric companies. One petition calls for the consolidation of four roads connecting Wakefield and Stoneham, another four roads in and around Brockton, and a third for the two roads in Gloucester. The consolidation of the above roads is in line with the policy of the Massachusetts Electric Companies to combine the thirty-nine roads under its control into three or four companies. The Railroad Commissioners have already approved the consolidation of the Norfolk County lines controlled by the Massachusetts Electric Companies.

PENNSYLVANIA AND OHIO NOTES.

Philadelphia, Pa., Dec. 26, 1899.

THE C & C ELECTRIC COMPANY, of New York, are notifying their customers and the trade about Philadelphia that their former Philadelphia manager, Mr. Wm. Myers, has suddenly left their employ. We learn that on Thursday, December 14, Mr. Myers disappeared under very peculiar circumstances. The company will be responsible for none of his actions, and will be glad to hear from any of our readers who may possibly learn of his whereabouts.

Pittsburg, Pa., Dec. 23, 1899.

THE UNITED TRACTION COMPANY reports for the month of November net earnings of $66,664 and a surplus of $19,620.

THE WESTINGHOUSE ELECTRIC & MANUFACTURING COMPANY has shipped two 500-hp generators to the Cuban Electric Company, of Havana.

MR. G. F. GREENWOOD, the general manager of the Havana Electric Railway Company, arrived in the city yesterday, and will stay in Pittsburg to spend the holidays with his family.

MR. DUDLEY PENDLETON, of the Pittsburg sales office of the Westinghouse Electric Company, left for Baltimore, Md., last night to spend the Christmas holidays with his parents.

THE ASSOCIATION OF ELECTRICAL CONTRACTORS of Pittsburg has elected officers for the ensuing year as follows: George R. Mathieu, president; J. M. G. Fulham, secretary; I. Patterson, treasurer.

ELECTRIC RAILWAY.—The county commissioners of Martin's Ferry, near Wheeling, have granted the franchise for an electric railway to connect Bridgeport, Colerain and Mount Pleasant, to Messrs. J. A. White and William McComas.

THE GERMAN TECHNISCHE VEREIN, of this city, an organization the members of which are chiefly electrical and mechanical engineers, celebrated its annual "commers" last Friday, and from all reports the usual delightful time was the order of the occasion.

Cincinnati, Ohio, Dec. 23, 1899.

A. G. SCHULMAN has the contract for dynamo, engine, wiring and switchboard to go in the Seasongood Building, at Third and Vine streets, now in process of remodeling.

MR. C. B. HUMPHREY, local manager of the Westinghouse Electric Company, entertained Col. J. M. Wilson at luncheon at the Business Men's Club Thursday. Mr. Wilson is a promoter of electric railways, and is from Dayton. He is popular in all the large cities of Ohio and neighboring states.

MANAGER W. F. HAYS, of the Cincinnati headquarters of the General Electric Company, is a member of the committee appointed by President Harrison, of the Business Men's Club, to bring conventions to Cincinnati. This committee is just now figuring on getting the next national democratic convention for Cincinnati. Mr. Hays has just returned from New York. He reports that his company is filling an order for $50,000 worth of supplies for northern Ohio.

THE CREAGHEAD ENGINEERING COMPANY has the contract to supply a full electric equipment for a tramway, electric light and mining plant in Georgia, near Gainesville. The company which is developing the mine—a promising gold field—will spend about a half million dollars opening it up. Westinghouse machinery will be used. The mill machinery will be furnished by the E. P. Allis Company, of Milwaukee. Work is to begin immediately after the holidays.

THE ELECTRIC RAILWAY EQUIPMENT COMPANY has just finished a very handsome and artistic new catalogue. Manager McCallum has an eye for the beautiful in printing, and believes thoroughly in appealing to the artistic as well as the business side of his friends and patrons, an evidence of which is seen in the pretty little holiday souvenir issued. It is in the shape of a diminutive trolley car and makes one of the prettiest Xmas remembrances of the season.

THE CINCINNATI ELECTRICAL TRADES' ASSOCIATION held its annual meeting and election last Tuesday at the Grand Hotel. T. J. Creaghead, of the Creaghead Engineering Company, was elected president; Martin Carlisle, of the Carlisle & Finch Company, vice-president; F. P. Lawrence, of the Standard Electrical Company, treasurer, and Secretary Mackelfresh, who has held that post several years, succeeds himself. The Executive Committee is: James Clarke, of Louisville; G. F. Brunt, of the Brunt Porcelain Company, East Liverpool, Ohio; Samuel Glover, president of the Post-Glover Company, Cincinnati, and James C. Hobart, of the Triumph Electric Company, Cincinnati. A dainty luncheon was served after the meeting. The general sentiment of members is that the trade is showing visible improvement.

Cleveland, O., Dec. 23, 1899.

THE ATHENS ELECTRIC & SUPPLY COMPANY, of Athens, O., has been incorporated with $5000 capital stock, to deal in electrical supplies.

INCREASE OF CAPITAL.—The Fremont, Fostoria & Findlay Traction Company increased its capital stock from $100,000 to $1,400,000 last week.

THE FOOS GAS ENGINE COMPANY, of Springfield, has increased its capital stock from $100,000 to $150,000. Extensive additions are being made to its plant.

ELECTRIC LIGHT FOR STATE INFIRMARY.—The commissioners of the State Infirmary, at Columbus, have authorized the purchase of an electric lighting plant to furnish light for the entire establishment.

MR. F. T. POMEROY, treasurer and general manager of the Cleveland, Berea, Elyria & Oberlin Electric Railway Company, gave a dinner in this city a few evenings ago to a number of employees and stockholders.

OHIO STREET CARS FOR GERMANY.—C. Roehr & Sons, street car manufacturers at Bucyrus, O., are at work on an order for double deck cars for the Manheim-Freiburg Tram Company, of Manheim, Germany.

LECTURE ON THE AUTOMOBILE.—The Electric Club, of Cleveland, held a meeting on December 13 and was entertained by an interesting and instructive paper on the automobile, by Elmer A. Sperry, of this city.

MORE TELEPHONES FOR MARYSVILLE.—William M. Armstrong, a prominent business man at Maryville, has been granted a franchise to operate a telephone system in that city and vicinity. Armstrong is said to be operating in connection with the Bell Company, and it is thought that a rate war will be instituted with the independent company already in the field.

ELECTRIC EQUIPMENT FOR A NEW BUILDING.—A generating plant and four electric elevators will be required in an immense nine-story apartment house soon to be erected in Cleveland. Specifications have been prepared by F. C. Bate, architect.

RAILWAY CONTRACTS TO BE LET.—The Youngstown & Sharon Electric Railway Company has succeeded in securing franchises for a greater portion of its route and contracts for the construction and equipment will be awarded in the near future.

THE ATHENS ELECTRIC & SUPPLY COMPANY, of Athens, was incorporated a few days ago with $5000 capital stock, to deal in mining and electrical machinery. The company will conduct an extensive repair shop and will make a specialty of rewinding armatures.

THE MARIETTA TELEPHONE COMPANY, of Marietta, has been incorporated with a capital stock of $50,000, to construct and operate a telephone company in Marietta, with toll line in the surrounding districts. P. H. Buck, J. S. H. Tornes, A. L. Garcey, Henry S. Ricker and J. W. Dusenbury were the incorporators.

A FORFEITED BOND.—Three years ago the Canton & Massillon Electric Railway Company forfeited a bond of $3000 for not building a branch from Massillon, and a suit to secure the amount is now pending. President Lynch now says his company is willing to build the branch and wants the county commissioners to arrange a new agreement.

THE JEWETT CAR COMPANY, of Newark, O., was recently incorporated in West Virginia for the purpose of manufacturing and selling street railway and other railway cars. The subscribed capital stock was $500, with a privilege of increasing it to $200,000. The stockholders are A. H. Sisson, W. S. Wright, H. S. Sands, Paul O. Reman, all of West Virginia, and C. E. Krebs, of Jewett, O.

THE BELLEFONTAINE, KENTON & LIMA ELECTRIC RAILWAY COMPANY was incorporated last Wednesday for $100,000 by William H. Miller, Frank B. Williams, Robert G. Ferguson, Reid Dunlop, J. K. Pierson and O. W. Williams. The company is at work securing franchises on a road to connect Bellefontaine and Lima, passing through Allen, Auglaize, Logan and Hardin Counties.

MR. WALTER B. BROCKWAY, secretary and auditor of the Toledo, Bowling Green & Fremont Electric Railway Company, has resigned his position, to take effect January 10, having accepted the position of auditor and assistant secretary of the New Orleans & Carrollton Electric Railway Company, which has recently been equipped with electricity. Mr. Brockway is also secretary of the Street Railway Accountants' Association.

INCREASE OF CAPITAL.—The Alliance, Sebring & Salem Electric Railway Company, which was incorporated some time ago for $100,000, has increased its capital stock to $300,000. A proposition made by a Philadelphia construction company to construct and equip the entire road, has been accepted and contracts will be placed in the near future for the entire equipment. It is proposed to commence work on the road in the early spring.

THE CLEVELAND ELECTRIC ILLUMINATING COMPANY has contracted with the city of Cleveland to furnish 890 lights, more or less, at the rate of $87.60 per light per year. Last year the rate was $89.88. The city of Toledo has contracted with the Toledo Traction Company to furnish lights for five years at the rate of $83 per light. The rate in Cincinnati is $84.90, Dayton $100 and Columbus $74.50. The contract in Columbus covers dark hours only.

THE COLUMBUS ELECTRICAL SUPPLY & CONSTRUCTION COMPANY, of Columbus, was incorporated last week for $10,000. The company will succeed to and enlarge the stock and business of the Paul B. Chaney Company at 80 East Gay Street. The incorporators were Paul B. Chaney, Mark Simonton, John Cashatt, Wm. A. Simonton and William H. Sharp. Mark Simonton, one of the officials in the company, has recently finished a course in electrical engineering in the Ohio State University.

CONTRACTS WERE LET last Monday to the United States Construction Company, of Cleveland, for the building of a new suburban line to be known as the Massillon, Akron & Cleveland Electric Railway. The contract price is said to have been $950,000. The main line will be 63 miles long, running through Lawrence, Franklin, Barberton, Akron, Hudson and probably Medina. It is proposed to run into the city over a private right of way. A large power house will be located centrally between Massillon and Akron. Cleveland, Akron and Massillon capitalists are back of the project.

NEW RAILWAY POWER HOUSE.—The Toledo & Maumee Valley Railway Company is erecting a power house at Maumee which will be operated by both water and steam power. The water power will be used at least six months in the year, water being taken from the Miami Canal, with about 40 miles of slack water between Maumee and Defiance. At Maumee there is a 60-foot fall through a 6-foot steel tube from head gates under the water wheel, a distance of 240 feet. The water wheel is of 600-hp capacity, built by the James Leffel Company, of Springfield, and the governor is of the Lombard type. The inside equipment consists of one 500-hp Hamilton Corliss engine, two 300-kw General Electric Company's generators, one 150-kw General Electric booster and four 125-hp boilers. The power house is 60x150 feet, built of brick, with steel roofing. The plant and electric railway will be in operation in about sixty days.

THE LINCOLN ELECTRIC COMPANY, of Cleveland, has been expanding rapidly of late. Contracts were closed recently with the Iowa Electric & Construction Company, of Des Moines, to handle its line of goods in Iowa, and with Paul T. Kinney, of New York, for New York and vicinity. The company is paying special attention to a slow speed motor for use in connection with printing presses, and has recently equipped plants for the O. S. Hubble Printing Co. and the A. S. Gilman Printing Company, of Cleveland. The machines for the latter company are direct connected to the presses. Work is under way for two large motors for England, three knitting machinery motors for Brooklyn, one 15-hp motor for Galveston, Tex., and an elevator motor for Chicago. The call for the automobile motor is on the increase. A test made a few days ago by the firm of Sipe & Sigler to determine the best motor for use on their carriage showed an efficiency of 82½ per cent. for the Lincoln motor, several points higher than that of any other machine tested.

WESTERN NOTES.

Chicago, Ill., Dec. 23, 1899.

STREET RAILWAY FRANCHISE INVESTIGATION.—The Chicago city council has authorized the mayor to appoint a commission of seven aldermen to investigate the whole street railway problem in anticipation of the application of the surface roads for an extension of their franchises, which expire soon.

POWER PLANT FOR THE ARMOUR ESTABLISHMENT.—A large electric power plant, capable of furnishing power for the whole establishment, is to be put in place at Armour & Company's packing house soon after Jan. 1.

The cost of the equipment, it is stated, will be over $1,000,000. The substitution of electricity for steam it is thought will save money in the long run so appreciably that the $1,000,000 will come back to the company in a few years.

THE NORTHWESTERN ELEVATED RAILROAD.—In order to avoid the forfeiture of the $100,000 bond deposited with the city treasurer and the necessity of asking the council for another ordinance the provisions of which may be less lenient than those of the present grant, the Northwestern Elevated Railroad Company will make strenuous efforts to complete the structural work and have at least one car operating on the many miles of track before Dec. 31—the limit established by the council.

AUTOMOBILE CLUB IN CHICAGO.—The Automobile Club of Chicago has been incorporated, with J. Ogden Armour, E. Walter Herrick, Samuel Insull, F. K. Pulsifer and Andrew R. Sheriff as the incorporators. The new club has for its objects the promotion of the automobile industry and of social relations among those who use horseless vehicles. It is proposed by the club to arrange and manage races and tours on automobiles, to encourage the adoption of uniform rules for the safe use and operation of such vehicles in public places and to promote social fellowship among users of them. The number of private automobiles in Chicago is estimated at 250.

AUTOMOBILES IN CHICAGO.—In preparation for the expected influx of automobiles, which is scheduled to take place at the first of the year, Mayor Harrison has ordered the enforcement of the ordinance which requires the licensing of all the operators after an examination by a board. The board has been organized and consists of Superintendent Ellicott, of the Electrical Bureau, as chairman; Health Commissioner Reynolds and City Engineer Ericson. It will begin examining and licensing the operators immediately. The reason for this is that a number of serious accidents due to incompetent motormen have recently occurred. The tests will take place in Garfield Park, where the cycle path will be used for the purpose. Dummy figures of pedestrians and vehicles will be placed along and across the path and applicants will be required to steer their vehicles in such a way as to demonstrate their command over the machines as well as their quickness of sight and coolness. The newly incorporated electric vehicle company, which starts with a capital stock of $500,000, promises to put 50 cabs on the street by Christmas Day and 1500 by the first of May. It has acquired stands at all the railway stations and theatres, as well as the principal hotels.

Milwaukee, Wis., Dec. 23, 1899.

RAILWAY SERVICE IN RACINE.—Heretofore, the Milwaukee, Racine & Kenosha Electric Railway has refused to carry local passengers in Racine. The protests of the city has obtained the right for its citizens to board the interurban cars in that city for local transit.

NEW TELEPHONE EXCHANGES.—Early in the spring small telephone exchanges will be established at Pittsville, Dexterville and Babcock, to connect with the Wood County telephone exchange. The necessary amount of stock has already been subscribed by merchants in the three towns.

THE WISCONSIN STATE UNIVERSITY.—A new piece of apparatus which has been recently secured by the Department of Electrical Engineering at the State University, has just been received. It is a combination direct and alternating current dynamo, which will be of great value for instructional purposes. The dynamo was built by the Northern Electrical Manufacturing Company, of Madison, Wis.

JOHNSON-FORTIER WIRELESS TELEGRAPHY.—A project is being worked up to establish the Johnson-Fortier wireless telegraphy system on the lake shore. It is proposed to have stations at Milwaukee, Racine, Kenosha, Waukegan and Chicago, and vessels plying between Chicago and Milwaukee would be equipped with apparatus. It is stated that a company is being formed to push the project.

THE WISCONSIN TELEPHONE COMPANY will put several large crews of men at work at Fond du Lac to build additional lines. It is stated that within a year the Wisconsin Company will have 2000 telephones, connected and working in Fond du Lac. A large cut in prices for service is very likely to be made to meet the prices of the Little Wolf River company, and free telephone service, for the purpose of settling the question of supremacy of companies in this city is looked for.

ELECTRIC LIGHT IN RACINE.—An ordinance has been introduced in the common council of Racine in favor of granting to ex-Mayor M. M. Secor the right to build, maintain and operate an electric lighting plant in the city of Racine, which is to be modern in every way. Recently the Milwaukee Electric Railway & Light Company got control of all the electric lighting business in the city and prices in many instances have advanced.

A NEW TELEPHONE LINE is to be built from Green Bay to Oshkosh, and extended to take in a large part of the Fox River Valley. The Little Wolf River company has just purchased the franchise of the Northeastern Wisconsin Telephone Company, whose lines run west from Green Bay. It is now operating the recently purchased lines as well as its own original lines. It is the intention of the company in building the new Oshkosh line to connect with the Western Oshkosh lines of the Northeastern Wisconsin Telephone Company, thus making a circuit of the Fox River Valley.

Minneapolis, Minn., Dec. 23, 1899.

THE WESTERN ELECTRIC COMPANY, of Chicago, is to furnish a 100-kw 125-volt direct-current direct-connected generator for the Hennepin County Court House.

THE PIONEER IRON MINING COMPANY, Ely, Minn., has displaced hand work on its stock pile trestles by electric motors. An underground electric system has also been installed.

THE PEPIN TELEPHONE COMPANY is to build a line from Pepin to Nelson, connecting Pepin County, Pierce County and Buffalo County lines with Wabasha and Winona, Minn.

THE COLUMBIA HEIGHTS ROLLING MILL COMPANY, Minneapolis, has lately added an electric locomotive and an electric feeder to its equipment. Current is obtained from the street railway company's lines.

MR. C. L. PILLSBURY, formerly city electrical inspector of Minneapolis, has resigned and accepted a position with the Minneapolis International Electric Company as superintendent. Mr. R. Dustin has been appointed electrical inspector.

NO POWER FOR THE ST. CLOUD STREET RAILWAY.—The St. Cloud street car system is tied up for the next ten days. The Benton Power Company, which owns the line, had expected to have its new plant in operation by Dec. 15, but failed to get it ready in time. The old power company refused to furnish current after the above date.

THE MINNEAPOLIS STREET RAILWAY COMPANY has begun operating cars on its new cross-town line on Eighth street, S. E. This line will probably be used instead of Fourth street by the "Como Interurban" next spring. A petition, signed by 500 residents of the west side, has been presented to the street railway company asking for a cross-town line on Franklin avenue.

Indianapolis, Ind., Dec. 17, 1899.

NEW TELEPHONE EXCHANGE.—Anderson has a new telephone exchange, costing $60,000, with 1600 subscribers.

MUNICIPAL ELECTRIC LIGHT.—Washington has taken steps through its common council looking to municipal ownership of the electric light plant.

INCREASE OF CAPITAL.—The Citizens' Telephone Company, of Decatur, filed articles with the Secretary of State, increasing its capital stock from $3600 to $6000.

THE CAIRO TELEPHONE COMPANY has been incorporated with a capital of $8000. A franchise has been granted to the company covering Tippecanoe, Carroll and White counties.

ELECTRIC POWER AND LIGHT FOR CELLULOSE PLANT.—A big cellulose plant, with buildings covering 20 acres, has been established at Linden by the Marsden Company. The plant will be operated by electric power, and lighted by electricity, and electric cars will be used for conveying the raw material in and the finished product out of the building to the railway.

THE TELEPHONE COMBINATION.—Local capitalists interested with G. W. Beers, the organizer of the big telephone combination, deny the report sent out from New York of the withdrawal of a number of wealthy men. They say that while their names are withdrawn from publicity their capital will stay in the company. Mr. Beers insists that the deal will certainly go through and has so notified the New Yorkers.

THE UNION TRACTION COMPANY.—The Union Traction Company has been granted the right to enter the city over the Central Avenue line. The route described includes the loop around Meridian, Maryland, Illinois and Washington streets and also to the Union Station. The petition asks for the privilege of charging a straight five-cent fare, with a view of discouraging local traffic inside the city limits. The privilege of carrying freight, express and United States mail is also asked. The only items or privilege not yet granted is the carrying of the mail and charging a straight five-cent fare. The terms are acceptable to the Indianapolis company.

St. Louis, Mo., Dec. 22, 1899.

ELECTRIC CARS ON BROADWAY.—Owl cars on the Broadway cable road are now operated by electricity instead of mules. The change was made last week.

THE MIDLAND ELECTRIC LINE of the United Railway Company, began operations Dec. 17. The fare will be 15 cents from St. Louis to Créve Cœur Lake. The line is 14 miles long and the time from the lake to the city will be an hour and a half.

ARTICLES OF INCORPORATION were filed Dec. 16 by the Consolidated Electric Company of St. Louis. The capital stock is represented to be $10,000. The holders of the stock are Chas. McD. Adams, John B. Slaughter, John M. Dickson, F. Kingsbury Curtis and Hugh H. Harrison.

THE TEN-YEAR LIGHTING ORDINANCE signed by the mayor, Dec. 7, became a law Dec. 18. It confers upon the board of public improvements the authority to let lighting contracts of ten years' duration west of Jefferson Avenue, with an incandescent gas mantle, to be used, and east of Jefferson Avenue specifying electric light.

RAILWAY FRANCHISE GRANTED.—The commissioners of Marion County have granted a franchise for an electric railway to a company of local promoters headed by Fred J. Scholz, ex-treasurer of state. Cleveland men are said to be interested also. The road when constructed will run between Indianapolis and Rushville.

THE FOURTH STREET LINE TO BE SOLD.—The State Supreme Court in an opinion by Judge Burgess affirmed the judgment of the St. Louis Circuit Court in the case of Rumsey vs. People's Railway, which ordered Commissioner Moffett to sell the Fourth Street lines of that company and apply the proceeds to the payment of debts.

TO TEST COUNTY COURTS' RIGHTS.—The St. Louis & Meramec River Railroad Company, which has been cited to appear in the St. Louis County Court to show cause why its rights under the franchise granted by that court to build, operate and maintain its railroad between the city limits of St. Louis and Kirkwood, should not be forfeited will not appear in court Dec. 18 in response to the citation, but will ignore the county court's order, on the ground that that tribunal is entirely without jurisdiction in the premises.

COUNTY COURT BLOCKED.—The St. Louis & Meramec River Railroad Company has appealed to the St. Louis Circuit Court in its troubles with the county court in the matter of franchise forfeiture. The officers of the company were cited to appear before the county court Dec. 18 and show cause why their rights and privileges should not be forfeited. Instead the county judges were each served with a copy of the writ of prohibition issued by the circuit court restraining them from further action. The case will come up Jan. 8.

IMPERIAL ELECTRIC REPORTED SOLD.—The Imperial Electric Light, Heat & Power Company, it is positively stated by an interested party, has transferred its stock, plant and business to another company, syndicate or association of capitalists, the identity of the purchaser remaining unestablished in a measure. It is stated that a majority of the stock has been sold and transferred to J. G. White & Co., of New York. It is also said that the stock had passed or was in a transitory progression, through middlemen, to Brown Bros., of New York, who are behind the United Railways deal, and that it was one of the steps toward the consolidation of street railway, electric and gas lighting interests of St. Louis.

THE ST. LOUIS STREET RAILWAY DEAL.—It is said that Brown Brothers, of New York, will not take up the option on the consolidated street railway systems of St. Louis by January 1, the expiration of their option limit. Failure of Brown Bros. to carry out their end of the negotiations will mean that instead of money being paid the stockholders of the various lines of the United Railway syndicate, the securities held would be surrendered by the New York brokerage firm which has attempted to engineer the deal, instead of the payment of the sum of $45,000,000 as conditioned by the option. Such a result will in no wise affect the present consolidation of the street railway lines of St. Louis, and the extensive preparations made for consummating such consolidation in the way of new power houses, uniformity of cars and an elaborate transfer system will stand as it has gone into effect. The Brown Bros., failing to take up the option, consolidation will then become a strictly local affair, owned, managed and operated by the same persons who held stock in the several lines at the time they were independent.

San Francisco, Cal., Dec. 16, 1899.

AN ELECTRIC LIGHT PLANT NEEDED.—Burns, Ore., is in need of an electric lighting plant and a water system.

MR. JOHN M. KLEIN, who has large electrical interests in San Francisco and elsewhere, recently returned from a trip to New York via the isthmus route.

NEW CARS IN SAN FRANCISCO.—The Market Street Railway Company, San Francisco, is building 24 electric cars for use on its Third and Kearny Street line. The capacity of each car is 50 passengers.

THE ELGIN LIGHT & WATER COMPANY was recently incorporated, with a capital stock of $1000. Principal place of business, Elgin, Ore. Incorporators, J. A. Masterson, Metty Masterson and Lizzie E. A. Kyle.

THE WHEELER COUNTY TELEPHONE COMPANY, of Waldron, Ore., has been incorporated, with a capital stock of $2000, by R. N. Donnelly, A. Fletcher and G. O. Butler. A telephone line from Waldron to Fossil is projected, to begin with.

ELECTRIC MINE DREDGING.—The Sacramento Electric Gas & Railway Company is constructing a pole line to enable electric power to be supplied for dredging purposes. The Boston Exploration Company is about to set up a mining dredger on Sailor Bar, and it will be operated by electric motors.

THE LONG BEACH & ALAMITOS GAS, ELECTRIC & POWER COMPANY was recently incorporated in Los Angeles. The directors are: F. H. Rindge, Santa Monica; H. V. Carter, G. I. Cochran, W. Gillelin, L. A. Phillips, Los Angeles, and W. J. Williams, Pasadena. Subscribed capital stock, $100,000.

WIRELESS TELEGRAPHY IN HAWAII.—The Inter-Island Telegraph Company, of Honolulu, was recently incorporated with a subscribed capitalization of $100,000. Marconi instruments for wireless telegraphy have been ordered and work will be commenced at once on the system, which will furnish communication between all the islands of the Hawaiian group.

MUNICIPAL LIGHTING IN TACOMA.—The city of Tacoma, Wash., has found it necessary to supplement its municipal supply of electricity for commercial and public lighting. The heavy overload at night has been responsible for very dim lights. So arrangements have been made to connect with the mains of the Snoqualmie Falls Power Company between the hours of 4 p. m. and 10 p. m.

THE GAMEWELL FIRE ALARM TELEGRAPH COMPANY has done a large amount of business in California this year, under Mr. A. J. Coffee, the manager for the Pacific coast. The Dalles, Ore., is installing a complete Gamewell non-interfering system. Nelson, B. C., is installing a similar plant. The Los Angeles system has been in successful operation for some months, and the 50 police boxes are now in use with a four-circuit central office, desk and storage battery.

ELECTRIC LIGHTING OF SAN FRANCISCO.—The San Francisco Electric Light & Power Company has been incorporated in this city by Andre Poniatowski, William Angus, William H. Crocker, W. Frank Pierce and Charles E. Green. The capital stock is fixed at one million dollars. This company will have an important bearing upon the future of electric lighting in San Francisco. It is reported that the new agreement between Prince Poniatowski's Standard Electric Company and the San Francisco Gas & Electric Company was not ratified. By the terms of the original agreement it was understood that the Gas & Electric Company would control a large part of the current, which the Standard Company proposed to transmit from Blue Lakes to San Francisco. Following upon the failure to come to an agreement the incorporation of a new local company by members of both companies gives an entirely new complexion to the distribution question. Mr. Charles E. Green, whose name appears among the incorporators of the new company, has been connected with the electrical end of the San Francisco Gas & Electric Company. It is understood that the newly incorporated company will handle the Standard Company's current in a wholesale manner. It will be able to supply any desired amount of electric power to any number of local companies who may need the same for lighting and power circuits. Large manufacturers could be supplied direct from the new company's lines. In this way competition in distributing the cheap power would be furthered instead of restricted. The matter of furnishing current for a distributing system that might be installed by the city for public lighting has been considered. The Standard Electric Company is preparing to construct its new generating station four miles up the Mokelumne River from the Blue Lakes plant, which was damaged by fire. It is intended to transmit current to San Francisco early in 1901. About 14,000-hp will be available here.

CANADIAN NOTES.

Ottawa, Ont., Dec. 23, 1899.

SARNIA STREET RAILWAY.—At a meeting of the Sarnia Street Railway Company's stockholders, of Sarnia, Ont., the question of converting the railway into an electric system was discussed and a by-law authorizing the directors to raise $60,000 by debentures for the carrying out of the work, was passed.

AN ELECTRIC RAILWAY ALONG THE YUKON.—Application will be made at the ensuing session of Dominion parliament for the incorporation of the Alaska & Northwestern Railway Company, to construct and operate a steam or electric railway from Pyramid Harbor, on the Lynn Canal, through the Chilkat Pass, and thence by way of the Dalton Trail to Fort Selkirk, in the Canadian Yukon district.

THE SOULANGES CANAL.—A successful test of the electric plant and lights on the Soulanges Canal has just been made. The line, which is to be used exclusively for the Soulanges Canal, will furnish light and convey power to open bridges and lockgates. There will also be a telephone line connecting all the locks, bridges and offices. Alternating arc lamps are used, giving light for over 100 hours on one run.

THE CASE OF THE HULL ELECTRIC COMPANY.—The court of appeal in Montreal has delivered judgment in the appeal of the Hull Electric Company against the decision in the Hull Company's case against the Ottawa Electric Company. The Hull Company entered action asking $20,000 damages and for an injunction compelling the Ottawa company to remove all its poles and wires and cease operating in the city of Hull, Quebec, claiming an exclusive charter. The trial judge dismissed the action and ruled that the Hull Company's charter was ultra vires, and the court of appeal sustained this ruling on all points. The Hull Company will now carry the case to the privy council.

General News.

THE TELEGRAPH AND TELEPHONE.

WINCHESTER, VA.—The Winchester Telephone Company will build about 30 miles of line at once.

AUBURN, ME.—The Eastern Telephone Company has in contemplation the building of lines in different sections of Maine. Mr. Maynard S. Bird is the manager.

CHARLESTON, W. VA.—The St. Marys & Union Mill Telephone Company, of St. Marys, W. Va., has been incorporated with a capital of $150; authorized capital, $2000.

ALBANY, N. Y.—The Columbia Long Distance Telephone Company has been incorporated, with a capital of $50,000. Its general route is from Albany to various points in the state.

TERRE HAUTE, IND.—The Citizens' Telephone Company, which owns a line from this city to the north, but which has no city exchange, is about to consummate a deal for the sale of the line to the Independent Company, of Indianapolis.

McKEESPORT, PA.—The McKeesport Telephone Company, it is reported, has sold its plant to the Federal Telephone Company for $70,000. The local company was organized about three years ago, and has about 800 subscribers in McKeesport.

DOVER, DEL.—The American Independent Telephone Company was incorporated here on Dec. 22, with a paid-up capital of $100,000, and with the power of acquiring telephone and other property to the extent of $10,000,000. Edward Troth, of Philadelphia, is named as the president of the company.

YPSILANTI, MICH.—Articles of association to incorporate the Washtenaw Telephone Company have been prepared. The new company will construct toll lines from this city to Stony Creek, Willis, Whittaker, Milan and York, in Washtenaw County; West Sumpter, in Wayne County, and Dundee, in Monroe County. Connection with the lines of the New State Telephone Company will be made in this city.

CORYDON, IND.—Arrangements are being made here to organize an independent telephone and telegraph company to operate a telephone exchange and toll lines in opposition to the Ohio Valley Telephone Company (the Bell Company). The local company will have long distance connections through the new Long Distance Telephone Company, of Indianapolis, and probably the Federal Telephone Company, of Ohio, and the big Mahoney syndicate, of New York.

DOVER, DEL.—The Berks County Telephone Company has been incorporated here, with a capital of $300,000. It is to construct and operate a telephone line through Berks County, Pa. The incorporators are Samuel Diebert, Lambert A. Rear, Captain Frederick M. Yeager, Reading, Pa.; Thomas McCorkle, president, and Frank Wood, superintendent, of the Delmarvia Telephone Company, of Wilmington; H. L. Evans, William S. Hilles and Charles C. Kurts, all the latter of Wilmington. It is understood that the Delmarvia Company intends to connect with this new opposition system to Reading by means of the Chester County Company.

PARIS, TEXAS.—Judge Don A. Bliss, of Sherman, heard in chambers an application of the Gulf, Colorado and Santa Fe Railway Company to enjoin the

Southwestern Telegraph & Telephone Company from entering upon its right of way to construct a telephone line. The injunction was granted on the grounds that the telephone company, being a foreign corporation, had no right under the laws of Texas to condemn for any purpose. This is the first time this particular point has been raised in condemnation cases, and, if sustained by the higher courts, will have a far-reaching effect, denying as it does the right of any foreign corporation to condemn lands in Texas for any purpose.

COLUMBUS, OHIO.—The Supreme Court on Dec. 19 in a test suit brought by the auditor of the state against the auditor of Franklin County, decided that telephone instruments must be placed upon the tax duplicates of the various counties at a valuation based upon their earning capacity. Only the wires, poles and other tangible property have heretofore been taxed. The instruments owned by the Bell Telephone Company were taxed at a valuation of $3.42 each, and it was the contention of the state that they ought to be taxed at their net rental value of $160 per instrument. It is estimated that there are 25,000 instruments in use in this state, representing an earning capacity of $5,833,000 and putting the telephone companies on the same basis as the express or telegraph companies, the state will gain in taxes about $80,000 annually.

ELECTRIC LIGHT AND POWER.

AKRON, O.—The Northern Ohio Traction Company is preparing to build a new brick electric light plant adjoining the present power house.

UNION CITY, IND.—The Municipal Electric Light & Power Company has been incorporated. Capital $20,000. Incorporators, D. Lesley, J. T. Gist, O. G. Gist, all of Union City.

HATBORO, PA.—The Hatboro Electric Light Company has decided to discontinue business. The streets of the borough will be lighted by the Jenkintown Electric Light Company.

BROWNSVILLE, PA.—The Brownsville Electric Light Company's plant will not be sold at sheriff's sale. The company will be re-organized as soon as the business of the old concern is settled up.

CHARLESTON, W. VA.—The United Light & Power Company, of Philadelphia, Pa., has been incorporated in West Virginia, with a capital of $1000 and an authorized capital of $5,000,000.

READING, PA.—The Berks Electric Light, Heat & Power Company has been incorporated here. Capital $5000. Incorporators, J. H. Printz, H. Godfrey, H. M. Albright, H. L. Greenawalt, H. Hahn, all of Reading.

LISBON, N. H.—The Lisbon Light & Power Company has been incorporated to furnish heat, light and power. Capital $30,000. Incorporators, H. C. Libbey, M. M. Stevens, H. B. Moulton, G. Brummer, L. C. Payne.

PLEASANTVILLE, PA.—The Pleasantville Electric Light & Power Company has filed articles of incorporation. The objects of the corporation are to operate and maintain an electric light plant at Pleasantville. The capital stock is $10,000.

MANDAN, N. D.—The Mandan Electric Company has duly organized and incorporated under the laws of the State. The authorized capital is $25,000, and the officers are as follows: President, H. R. Lyon; vice president, E. A. Hughes; secretary and treasurer, R. M. Tuttle.

CAMDEN, N. J.—The Pleasantville Electric Light & Power Company has been incorporated. Capital $10,000. Incorporators, A. Z. Banta, Warren L. Millham, Wm. H. Kreder, John McClintock, Jr., Peter B. Risey, E. H. F. Weaver, George H. B. Martin, Frank R. Hansell.

PASSAIC, N. J.—The Passaic Co-operative Lighting Company has been organized. It is composed of twenty of the largest storekeepers, and they plan to establish their own plant in the business district and supply their own lights. Work will at once be begun. The plant will be conducted on the co-operative plan.

SOUTH BEND, IND.—Articles of incorporation were filed in the county recorder's office by the Indiana Power Company, with a capital stock of $100,000, to erect a power dam across the St. Joseph River in Elkhart and St. Joseph Counties. The incorporators are Arthur Kennedy, of the Indiana Railway Company, Charles C. Black, Wilber L. Stone, and others.

MONTPELIER, VT.—The Consolidated Lighting Company is now furnishing light for Barre and Montpelier from its plant at Bolton Falls. The plant in this city will now be required to furnish only power for the arc lighting and for operating the electric railway, which requires less than 200-hp. There are at the Bolton Falls plant two dynamos with a capacity of 650-hp each.

PENNSBURG, PA.—An electric plant to furnish light for the streets of Pennsburg and East Greenville, and also current for commercial purposes, is about to be put in operation. It is proposed to utilize the water of the Perkiomen Creek for motive power. A company, headed by Frank G. Ortt, of New York, a former citizen of Pennsburg, has been capitalized at $12,000.

EASTON, PA.—The Easton Power Company has started its new water power plant. This plant is patterned closely after that of the Niagara Power Company. Two Westinghouse two-phase alternators are driven by turbines, belt-connected. The supply of water to the wheels is regulated by a Reynolds water governor. This plant is said to be the largest one in Pennsylvania operated by water power.

MT. HOLLY, N. J.—The sale of the Mt. Holly Electric Light Company to the American Investment Company was consummated a few days ago by the latter company securing a majority of the stock of the electric light company, for which they paid $150 per share, the par value of which is $100. The control will be turned over at once to the new company, which has already purchased the plant of the Mt. Holly Gas Light Company and the electric lighting plants at Moorestown and Haddonfield. These will be consolidated under one management.

WHITINSVILLE, MASS.—The Northbridge & Uxbridge Electric Company, whose plant is situated in North Uxbridge, is now in the hands of a syndicate that will control the electric power companies of Northbridge, Uxbridge, Grafton and Millbury. The main object of the combination is to consolidate the several plants into one station and supply the four towns. The electric power station at North Uxbridge will be abolished early in the spring and removed to a point near Uxbridge. The new syndicate is now looking over an old mill site in Wilkinsonville to be fitted up and used as the new central power station.

THE ELECTRIC RAILWAY.

ALBANY, N. Y.—The Albany & Hudson Railway & Power Company has filed with the Secretary of State a certificate of extension of its lines.

LEBANON, PA.—The Lebanon Valley Street Railway extension to Palmyra, ten miles west of this city, was opened a few days ago. The railway now has a continuous line from Palmyra, through this city, to Myerstown.

LANCASTER, PA.—The Conestoga Traction Company has been incorporated with a capital of $10,000. Incorporators, J. D. Skiles, J. W. B. Bausman, E. G. Smith, all of Lancaster; S. R. Shipley, W. B. Kurtz, of Philadelphia.

NEW YORK, N. Y.—The trustees of Larchmont have granted a franchise to the Larchmont Horse Railway Company in preference to the Union Railway, or "Huckleberry" system, which wanted to put a trolley in the Boston Post Road.

NEW YORK, N. Y.—The Butte Electric Railway Company has been incorporated with a capital of $1,000,000. Incorporators, W. A. Clark, of Butte, Mont.; J. A. McDonald, W. L. Hoge, J. C. Kennedy, all of New York City; H. Gatwater, of East Orange, N. J.

NORTHVILLE, MICH.—Northville is soon to have her second street railway line, as the Detroit & Northwestern electric road has its grading practically finished to the corporation limits, and barring unforseen delays will have its cars running by December 31.

DETROIT, MICH.—The right of way for the projected Port Huron & Lexington electric railway has all been secured up the St. Clair county line, also a considerable portion of it within the county up to the city limits. The promoters are confident of the success of the proposed venture.

NEW HAVEN, CONN.—Owing to the drought in the state the Consolidated Railroad is having much trouble getting water for its engines. At Berlin, where the main power plant of the road for the electric third rail service is located, the water supply has given out and locomotives have been substituted to haul trains on the line.

GARDINER, ME.—The Gardiner Street Railway Company was recently organized in this city, the incorporators being Freeman Patten, Charles Lawrence, Dr. John M. Turner, A. M. Spear, Dr. B. M. Turner, O. B. Clason and Will C. Atkins, all of Gardiner. Their purpose is to build a road from this city to South Gardiner, and they will begin operations in the spring.

DOVER, DEL.—The Doty Third-Rail Electrical Company has been incorporated here to manufacture electrical appliances for traction purposes. The incorporators are William W. Doty and William Reinhart, of New York; William F. Wilson and Harry C. Frank, of Mount Vernon, N. Y., and James Virden, Dover, and the authorized capital is $2,500,000.

NEW YORK, N. Y.—P. H. Flynn and his friends in control of the New York, Westchester & Connecticut Traction Company, have secured from the common council of New Rochelle a franchise in perpetuity for five miles of streets in New Rochelle, a gift which will enable Mr. Flynn, if he is not enjoined, to extend his trolley lines as far north as the boundary line of Mamaroneck.

FOSTORIA, OHIO.—The business men of this city intend to enter a vigorous protest against the increase in price now being charged by the Tiffin, Fostoria & Eastern Electric Railway between this city and Tiffin. They will ask the Baltimore & Ohio road to reduce their fare to that which the electric line is now charging in consideration of which the signers of the petition will use the B. & O. exclusively.

CONNELLSVILLE, PA.—The Mt. Pleasant, Scottdale & Connellsville Street Railway Company, which recently came into possession of the Connellsville, New Haven & Leisenring Street Railway Company's line, from New Haven to Graham's Crossing, as well as the Uniontown street railway, has decided to push matters this winter, and not to wait the advent of spring before making extensions to the line.

SPRINGFIELD, ILL.—A trolley car on the Eighth street line of the Springfield Consolidated Railway was blown up shortly before midnight, December 22, by a stick of dynamite which had been placed across the rails. This is the third car that has been dynamited since the street railroad strike began on Nov. 10. The car was badly wrecked and the track torn up. No passengers were aboard and the motorman was unhurt. The strikers disclaim responsibility for the act.

NEW YORK, N. Y.—The Appellate Division of the Supreme Court has handed down an opinion in the suit between the Tarrytown, White Plains & Mamaroneck Railroad Company, as respondent, and the New York, Westchester & Connecticut Traction Company, as appellant. The opinion says that the duty lies on the company of showing affirmatively that it has the necessary consent of the property owners to constitute a valid franchise for the construction of its railroad in the street. The plaintiff in this case entirely failed to sustain that burden.

BRISTOL, N. H.—A movement is on foot looking to the early construction of an electric railway to connect this town with Hebron, running via the town of Bridgewater. A charter for this road was obtained from the Legislature in 1893, and an organization, under the provisions of the charter, now exists. The new dam of the Bristol Electric Light Company, now nearing completion, will furnish about 175-hp, which is considered nearly double the amount that will be necessary to run the dynamos of the company, and it is proposed to use this surplus for the operation of the electric road, if built.

THE AUTOMOBILE.

THE ROTARY MOTOR VEHICLE COMPANY has been organized at Kittery, Me., for the purpose of manufacturing and dealing in traction vehicles, etc. The officers are: President, N. S. H. Sanders, of Danvers, Mass.; treasurer, W. R. Whiting, of Boston, Mass.

STANDARD AUTOMOBILE COMPANY has been incorporated at Chicago, Ill., to manufacture and deal in automobiles. Capital, $1,000,000. Incorporators, M. C. Alford, of Lexington; T. C. H. Vance, J. Huppaker, both of Louisville, Ky.; H. W. White, J. M. Wier, both of Chicago, Ill.

THE McPHERSON AUTOMOBILE COMPANY has filed articles of incorporation in Camden, N. J. The objects of the corporation are the manufacture and sale of automobiles. The capital stock is $20,000, and the amount paid in is $1000. The incorporators are S. C. Woodhull, Harry F. Carr and D. Trueman Stackhouse.

INDIANAPOLIS, IND.—The Greenfield & Indianapolis Electric Railway must run its cars by Jan. 1, in order to hold its franchises. This will be accomplished. Complaint has been made to the board of public works at Indianapolis that the company is building its line into the city without having secured the right of way. It is understood that the portion of the line in the city being built by the company is really the local company's line and merely fills the gap between the Shelby Street line and the city limits. The Greenwood cars will enter the city over the Shelby Street line.

FRANKLIN, IND.—The city council of Franklin voted a 30 years' franchise to the Indianapolis, Greenwood & Franklin Electric Railway line on Dec. 12. The franchise carries with it the right to use the streets without return to the city. The best streets of the city are given up to the tracks and no provision for paving between tracks is made. The city attorney had prepared an ordinance granting a franchise with numerous requirements and restrictions as demanded by the citizens, but this was ignored. The citizens were opposed to granting the franchise as asked, and ugly rumors are afloat and much indignation expressed. On account of an alleged error in the proceedings it is alleged that the granting of the above franchise was illegal. At a meeting of taxpayers it was decided to test the question in the courts.

NEW COMPANIES.

THE CLING SURFACE MANUFACTURING COMPANY, of Buffalo, to manufacture mechanical and electrical supplies. Capital, $25,000. Directors, Albert B. Young, Elizabeth, J. Young and William D. Young, of Buffalo.

THE ELECTRO-THERAPEUTIC OZONE COMPANY, of New York City, has been incorporated to treat diseases. Capital, $75,000. Directors, George W. Harris, Frank N. Armour, of New York City; Alan W. Wood, of Pittsburg.

ELECTRIC REGULATOR COMPANY, of Montclair, N. J., to manufacture electric regulators. Capital, $125,000. Incorporators, Eri F. Wilson, Charles H. Shelton, Roger Williams, Walter Kidde, Warren D. Batting, all of Montclair, N. J.

THE G. & S. ELECTRIC SUPPLY COMPANY has been incorporated to do an electrical business in Sioux City, Ia. The capital stock of the company is $10,000. Incorporators, M. A. Gurney, J. L. Follett, W. S. Sterling, all of Sioux City.

KEAN POWER COMPANY, of New York City, to manufacture and supply steam and electric power. Capital, $1000. Directors, Frederick W. Hunter, Cranford, N. J.; Augustus S. Newman, Garrisons, N. Y.; William V. Newman, New York City.

PERSONAL.

MR. W. J. JOHNSTON arrived at Amoy Dec. 23 from Formosa, where he formed one of a party of white men on a trip into the interior, to visit by invitation a tribe of head-hunters. Among the aboriginals a young man cannot marry until he has taken a head, and a press cablegram reports that Mr. Johnston saw the bodies of seven camphor workers who had just been decapitated, and that 38 Chinese and 14 Japanese had been killed during the year in the district visited.

DR. GEORGE SIEMENS, the director of the Deutsche Bank, has been created a nobleman of Prussia by the Emperor William. The distinction is a reward for Dr. Siemens' services in connection with the Bagdad Railway concession and the financing of the Anatolian Railway. George Siemens' father was the man who lent Werner von Siemens the six thousand thalers with which the now universally known firm of Siemens & Halske was founded in 1847. The newly created nobleman is about 60 years of age and has been at the head of the Deutsche Bank since 1870. Previously he superintended the erection of a considerable portion of the Indian telegraph lines on behalf of his uncle Werner.

MR. EDWARD P. BURCH, electrical engineer for the Twin-City Rapid Transit Company, has resigned his position with the company, to become a consulting engineer. Mr. Burch has been the company chief electrician for nearly eight years. Among more recent work he has installed and supervised the operation of the electrical apparatus at the new 10,000-hp water power plant of the Pillsbury-Washburn Company, in Minneapolis, and has had entire charge of the Twin-City Rapid Transit Company's substations in Minneapolis and St. Paul. The power plant has ten 1000-hp direct connected units. Power is transmitted from three to ten miles through paper insulated underground cable by three-phase alternating currents at 3500 and 12,000 volts and is transformed and converted at substations into direct current at 600 volts for the entire railway system of Minneapolis and St. Paul. This was the first large installation of the kind. The system has been in operation over two years.

OBITUARY.

MR. E. V. CHERRY.—A whole host of old-timers will regret to learn that Major E. V. Cherry, president of the Standard Electrical Works of Cincinnati, Ohio, died from pneumonia at Denver, Colo., on Dec. 18. He was at one time a member of the well known old firm of Post & Sons, of Cincinnati, who were leading dealers in railway supplies and electrical apparatus in the west for many years, and one of the early concerns to take a manufacturing license from the Bell Telephone Company. The Standard Electrical Works made a familiar line of telephone apparatus for several years, until at last it went through some process of absorption. Major Cherry, who won his rank in the civil war, was quite prominent in the social and political life of Cincinnati, and was formerly a member of the board of aldermen.

Trade and Industrial Notes.

AUTOMOBILE CARRIAGE BODIES.—The B. C. Body Company, of Bellefontaine, O., has published a catalogue describing a large line of carriage bodies, especially designed for automobiles.

THE ELECTRICAL CONSTRUCTION SUPPLY COMPANY, Springfield, O., has issued a folder pointing out the features of the Chubbuck patent malleable iron wall, roof and hood bracket and the Chubbuck pin and break-arm. The various devices are illustrated.

WIRING TABLES.—The Western Electric Company, Chicago, has brought out a special pocket edition (6½x4½ inches) of Mr. Thos. G. Grier's book, entitled "Wiring Tables; How They Are Made and How to Use Them." It is revised and enlarged.

THE EMERSON ELECTRIC MANUFACTURING COMPANY, St. Louis, Mo., has issued three slips calling attention to its slow speed alternating current motors, family sewing machine motors and tablet boards. Those interested are invited to send for bulletins on these subjects.

THOMPSON, SON & CO., 107 Liberty street, New York, dealers in new and second-hand electrical machinery, report business on the boom just now in every line they represent. They have taken the agency for the American dynamo brush and other goods of the Maine Electric Company, both well and favorably known in the trade.

THE CHICAGO MICA COMPANY, Valparaiso, Ind., has issued a circular announcing its removal to its new factory, which was referred to in these columns a few weeks ago. This company manufactures "Mica Bond," and will place upon the market a full line of prepared bond papers, linens, muslins, canvas, etc., and a special insulating compound of thoroughly tested merit.

THE RACINE HARDWARE COMPANY, Racine, Wis., in a neat little pamphlet, just issued, describes and illustrates Racine automatic engines. These engines are of the vertical type, and are especially adapted for operating electrical apparatus, both direct-connected and belted, although they are equally well suited for other purposes requiring uniform power, close regulation and extreme economy.

MR. J. GEISEROWICH, secretary and treasurer of the Illinois Insulated Wire Company, Sycamore, Ill., reports that they have recently secured several large contracts for their "Index" brand weatherproof wire, which keep them busy to their utmost capacity. The consumers who have dealings with them duplicate their orders constantly. They have also added recently a number of machines which have increased their output largely, so that they are now better able to keep pace with their orders.

POWER AND LIGHTING GENERATORS.—The Western Electric Company has recently issued Bulletin No. 3003, descriptive of power and lighting machines. It contains illustrations of the different types of belt-connected generators, and gives a full description of the general details and construction of the machines. A complete list of slow-speed multipolar motors from 3 up to 300-hp, for 110, 220 and 500 volts, and a list of slow-speed belt-driven multipolar dynamos, from 3 to 250-kw, are given.

JAS. L. ROBERTSON & SONS.—Attention is called to a pertinent statement made by Jas. L. Robertson & Sons, 203 Fulton Street, New York City, that few owners of steam plants realize how far-reaching cheap packing is in bad results. Not being made of substantial material it needs tighter pressure on the rod to make a tight joint. That means undue friction, loss of power and wear of the rod, soon necessitating turning down by a machinist at considerable expense. They claim special merits for Eureka packing in these respects and would like to demonstrate it to anyone making inquiry.

THE JEWELL ELECTRICAL INSTRUMENT COMPANY, 439 Marquette Building, Chicago, has issued its 1900 price list of Jewell standard meters, which are designed for direct current only. These meters are of the D'Arsonval type, having a coil moving in the field of a permanent magnet. In their construction special care is taken and specially prepared material used. The following are among the strong features claimed for these instruments: Rigidity of construction; dead-beat qualities; constant temperature coefficient; freedom from magnetic lag, and small energy consumption. These instruments are manufactured for the Jewell Company by the McIntosh Battery & Optical Company, and were designed and patented by Mr. Edward W. Jewell.

THE IRON CLAD RESISTANCE COMPANY, of Westfield, N. J., has gotten up a unique souvenir in the form of a paper weight, which is an exact reproduction in miniature of one of the types of iron clad rheostats made by this firm. The iron body of the paper weight is finished in finely polished black, while the contacts and lever are in lacquered gold finish. The Iron Clad Resistance Company informs us that it has about completed a large two-story addition to its works, and will now have practically double the manufacturing floor space it had when it commenced business a little over a year ago. This addition was necessitated by the large and increasing orders for standard and special rheostats and theatre dimmers, which are constantly being received from this country, as well as abroad.

THE AMERICAN SCHOOL OF CORRESPONDENCE, Boston, Mass., claims to be the only correspondence school in the country making a specialty of steam, electrical and mechanical engineering. The instruction papers bear evidence of careful and painstaking preparation. The courses have been carefully laid out by prominent educators and engineering experts, and embrace every subject required by the up-to-date engineer and mechanic in order to have complete mastery over the theoretical details of his daily work. By taking advantage of this school's offer, the ambitious mechanic can receive a thorough technical education in his profession by merely devoting his spare moments to systematic home study. The school will be glad to furnish a catalogue on request, describing its methods, and letters from graduates giving results of their experience.

WESTERN ELECTRICAL SUPPLY COMPANY, St. Louis, have sent out to all their trade as a Christmas remembrance a very handsome souvenir in the shape of an aluminum pocket cigar case, filled with good cigars, a useful as well as a very satisfactory present to most men. The case is a very handsome one. They state that their business in every department has far exceeded their greatest expectations, and, wishing to thank their numerous friends and customers, thought that this novel method of getting at all of them would be the most acceptable. No supply house in the country has grown more rapidly and solidly than this one. Their policy of giving all orders, whether small or large, their best attention, has succeeded, and to-day they stand in the front rank as one of the largest supply houses in the country, with a reputation that is enviable. They report that the outlook for business in 1900 is extremely good.

ELECTRICAL AND SCIENTIFIC INSTRUMENTS.—Mr. Elmer G. Willyoung, 82-84 Fulton street, New York, has issued a new and complete catalogue of electrical and scientific instruments and apparatus, manufactured by himself. These include adjustable condensers, switches, galvanometers, resistances, standard cells, Roentgen ray apparatus, etc. The catalogue covers a wide scope, and the variety of instruments illustrated and described may be a surprise to many. Its contents are arranged in a logical manner. Preceding the descriptive matter is considerable general engineering information and data. That, too, is arranged in a manner out of the ordinary, and the facts are clearly presented and accurate. The catalogue has been prepared with great care, and contains 176 pages. Mr. Willyoung manufactures a full line of electrical instruments of precision for laboratory and commercial work, in addition to special measuring instruments for special purposes.

Record of Electrical Patents.

UNITED STATES PATENTS, ISSUED DEC. 19, 1899.

[In Charge of William A. Rosenbaum, 177 Times Building, New York.]

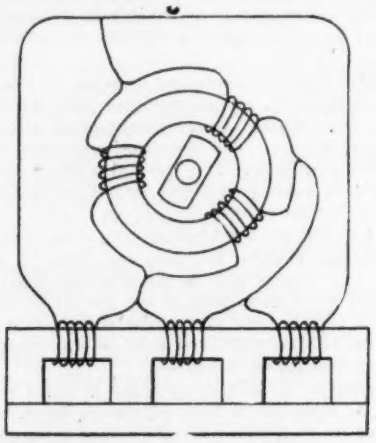
639,235. CONDUIT PLOW; E. M. Hewlett, Schenectady, N. Y. App. filed Jan. 29, 1898. The shoes on each side of the plow are mounted in such a way that they make a trailing connection with the conductors.

639,252. CONTACT SHOE FOR SURFACE CONTACT RAILWAYS; M. T. A. Kubierschky, Berlin, Germany. App. filed May 3, 1899. The essence of the invention is a shoe having a tread which is alternately wide and narrow, so that the entire surface of the contact stud in the roadbed is traversed by the shoe as the latter slides along. The object is to provide a shoe, the narrow portions of which will cut through ice and dirt, while the wider portions will prevent grooves being cut in the face of the stud by such narrow portions.

639,276. ELECTRIC TRANSFORMER; J. W. Packard, Warren, Ohio. App. filed Jan. 19, 1899. (See Current News and Notes.)

639,291. AUTOMATIC TELEPHONE; E. E. Ries, New York, N. Y. App. filed Aug. 7, 1897. (See page 1011.)

639,447. POLYPHASE ALTERNATING CURRENT MAGNET; W. M. Scott,



639,447.—Polyphase Alternating Current Magnet.

Philadelphia, Pa. App. filed June 11, 1898. The magnet core has three or more legs. Coils are wound on between the legs and these coils carry alternating currents of different phase. The magnetic streams set up by the coils unite and form a resultant stream or streams of non-interrupted flow whose continuity is independent of the relative directions of the component streams.

639,459. ELECTRIC GROUND DETECTOR FOR CONSTANT CURRENT ARC LIGHT CIRCUITS; J. F. Stevens, Philadelphia, Pa. App. field Sept. 25, 1899. (See Current News and Notes.)

639,464. COUPLING FOR ELECTRIC OR OTHER WIRES; R. Thompson, Newark, N. J. App. filed Oct. 11, 1899. The joint consists of a split sleeve having one or two slots formed in the upper side thereof, through which pass hooks formed on the ends of the wires; this is especially adapted for trolley wires.

639,505. ELECTRICAL TRANSFORMER; A. F. Berry, Market-Harborough, England. App. filed June 16, 1897. (See Current News and Notes.)

639,526. APPARATUS FOR TELEPHONIC SYSTEMS; F. B. Cook, Chicago, Ill. App. filed Nov. 30, 1894. (See page 1011.)

639,527. DROP RESTORING DEVICE FOR TELEPHONE SWITCHBOARDS; F. B. Cook, Chicago, Ill. App. filed Nov. 20, 1896. (See page 1011.)

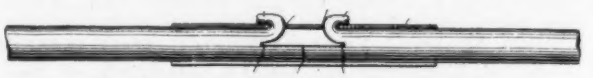
639,528. TELEPHONE TRANSFER BOARD; F. B. Cook, Chicago, Ill. App. filed Dec. 22, 1896. (See page 1011.)

639,557. ELECTRICAL SNAP SWITCH; M. Guett, Hartford, Conn. App. filed Oct. 28, 1899. The invention resides in a switch having a plate that can be arranged to be reciprocated or oscillated by a spring, push button, turn button or lever.

639,590. ELECTRIC TRANSFORMER; A. H. Loring, Minneapolis, Minn., and H. L. Clark, St. Paul, Minn. App. filed June 24, 1899. (See Current News and Notes.)

639,652. SECONDARY BATTERY; O. Behrend, Frankfort-on-the-Main, Germany. App. filed Oct. 30, 1899. (See Current News and Notes.)

639,688. CIRCUIT BREAKER OR LINE OPENER; F. C. Robertson, Toronto, Canada. App. filed June 25, 1898. A resistant wire is coiled around a tube or rod capable of expanding when heated. Excessive current heats up the tube, causing it to expand and close a pair of contacts.



639,464.—Coupling for Electric or Other Wires.

639,690. ELECTRIC CANE; W. M. Sherman, Mercede, Cal. App. filed Feb. 4, 1899. The head of the cane is hollow and carries either an incandescent lamp and battery, or a medical coil, battery and outfit. If the light is used a bull's-eye is inserted in the head of the cane immediately in front of the light. The medical apparatus may be used while in the cane or taken out and used separately.

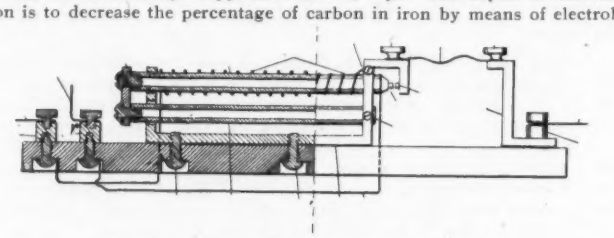
GERMAN PATENTS, ISSUED DEC. 6, 1899.

[In Charge of Dr. Ralph Julian Sachers, 120 Liberty Street, New York.]

105,408. ELECTRICALLY HEATED VAPORIZER; Carl Bentner, Grunewald. App. filed Nov. 10, 1898. A hydrocarbon, as, for instance, gasoline, is vaporized by means of a heating coil dipped into it. The production of gas is automatically regulated by the volume of gas, which by its increase reduces the heating surface surrounded by the gasoline and, therefore, also the production of gas and vice versa.

105,409. IGNITER FOR GAS LAMPS; Fritz Deimel, Berlin. App. filed Feb. 10, 1898. (Addition to patent 100,883, dated Oct. 26, 1897.) The igniter is provided with a source of electric current, for instance, a primary cell or an accumulator, located within the handle, which source is connected to the igniting pill or capsule by means of insulated wire, ending in a loop of platinum wire surrounding said igniting pill.

105,572. METHOD OF ELECTROLYTIC DECARBONIZATION; Heinrich Bumb, Charlottenburg. App. filed Dec. 2, 1898. The object of this invention is to decrease the percentage of carbon in iron by means of electrolysis



639,688.—Circuit Breaker or Line Opener.

of the chlorine compounds of aluminum, chromium, magnesium, manganese and tungstate, simultaneously with the perchloride of iron, by means of funnel-shaped decomposing cells. A funnel containing the metal-salt to be electrolyzed, dips with its lower opening into the molten alloy. In the process of electrolysis, the metal freed from the electrolyte combines with the molten metal whereby this becomes enriched, showing at the same time a relative decrease in its percentage of carbon.

105,299. ELECTROLYTE FOR ELECTRODEPOSITION; E. Courant, Berlin. App. filed Sept. 11, 1898. This electrolyte consists of the cyanide of potassium double salts of the metal to be deposited, treated with sulphurous acid. These salts are very constant and if dissolved in water are immediately ready for use.

ELECTRICAL WORLD AND ENGINEER

ELECTRICAL WORLD AND ENGINEER, Vol. 34, No. 27.

NEW YORK, DECEMBER 30, 1899.

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Classified List of Advertisers, Pages 27, 28, 30 and 32.

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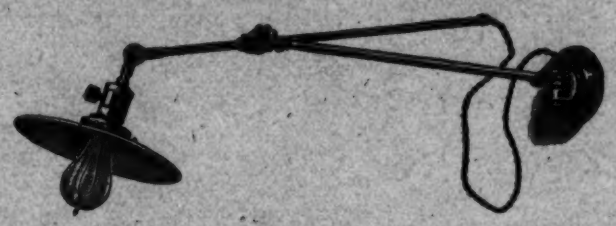

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We "Double the efficiency and convenience of incandescent light." Send for our Catalogue D.

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Manufacturers of
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Contractors for Complete Installation of Conduit Systems.
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The most perfect now on the market.
WE GUARANTEE EVERY ROLL OF TAPE BEARING OUR TRADE MARK.
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WE OFFER AS ADVANTAGES:

Steady light at all times and speeds; no attention except to turn on and turn off lights; reserve storage capacity of 20 hours for use when car is stationary; each car is independent and complete in itself; electric fans, a much appreciated luxury; cost less than that of any oil or gas system; all the advantages of ELECTRIC LIGHTS—no smoke, no smell, no danger from fire; every seat has a light, and more light than with any other system. We can demonstrate our claims if you will write us.

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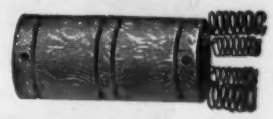

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Iron Clad Resistance Co.

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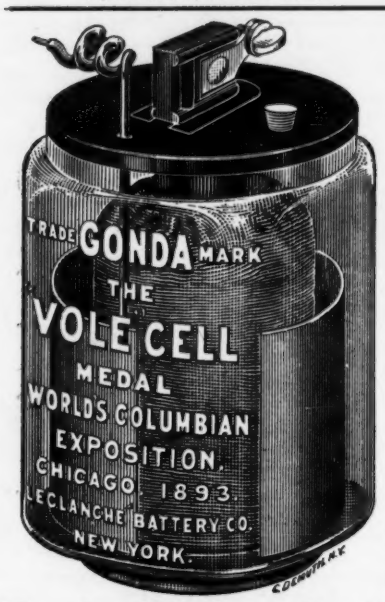

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SACHS NOARK FUSE.

For all Voltages.
Does Not Arc,
But Indicates.

500 Volt Fuse. Type A Contact.

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Notice its Construction. Metal parts insulated with sheet mica, and water-proofed with moulded mica.

No danger of Lamp falling.

Strongest, most perfectly insulated Hanger on the market.

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We have just put on the market a special very low priced, first-class lamp.

Every lamp guaranteed.

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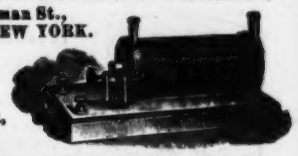

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Send for description and price.

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FOR BATTERIES. BETTER THAN SALAMMONIAC.

FEDERAL BATTERY CO.,

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MANUFACTURERS, EXPORTERS, WHOLESALERS } GENERAL ELECTRICAL SUPPLIES

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To obtain increased economy of fuel, labor and repairs—to prevent severe strains upon generating machinery—to reduce liability of breakdowns—to increase station capacity—

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is a Blessing to Every Engine Room and Machine Shop.

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An unknown resistance found in 12 seconds by an inexperienced man. Can this record be beaten? Write us.

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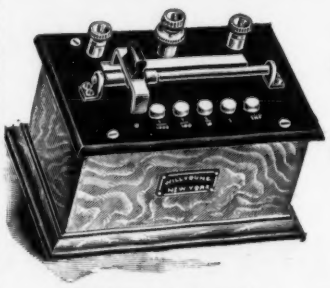

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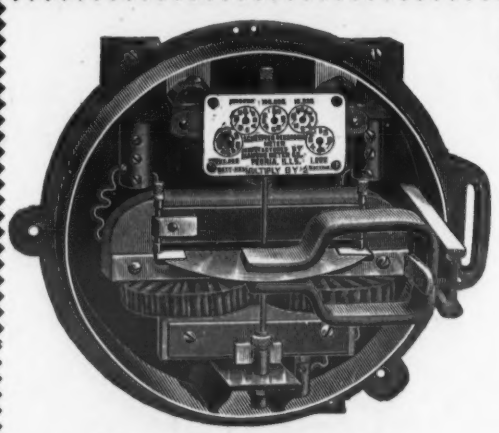

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ROUND PATTERN-Type D.
DUST PROOF METER.
For ALTERNATING CURRENT.

Shunt loss less than one Watt on 60 cycles.
Correct on induction loads. Starts on 5 Watts.

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STEAMBOAT HEADLIGHTS.

ALL SIZES. ANY CANDLE POWER.

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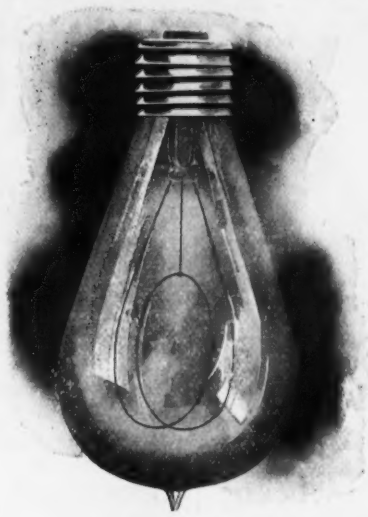

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110 VOLTS. 10, 16, 20, 32, 50, 100 CANDLE POWER.

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Catalogue 1-S gives complete description and illustration of the New Type Sunbeam lamps, made by new machinery and latest improved methods. Every lamp exhausted individually.

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MANUFACTURERS AND DEALERS,

Electric Light and Power Apparatus,
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Did you ever consider the losses and expense which can be avoided by the use of Wattmeters which register all the current passing through them, and require no attention?

Stanley Wattmeters

HAVE MERIT and are approved wherever used.

The only meter which stays calibrated.
Magnetic Suspension eliminates friction.
No Jewels to roughen and crack.
Accuracy at all loads makes small business profitable.
Most substantially made; neat in appearance.
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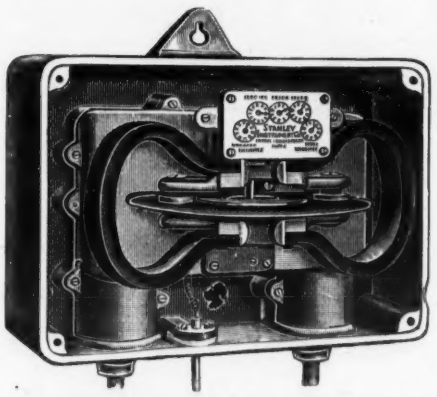

Stanley Wattmeters are Sealed and Guaranteed FOR THREE YEARS.

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ACCURACY of Record,
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WRITE for bulletin and prices.

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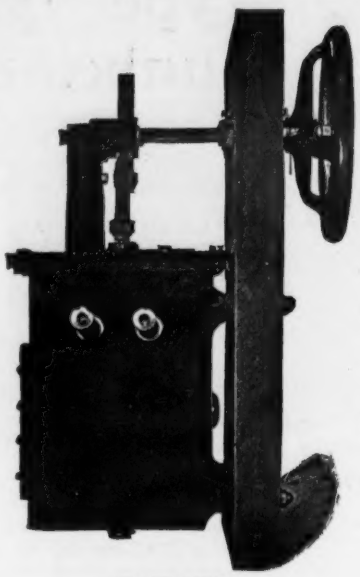

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THE CLOOS OIL BREAK SWITCH is positively the only form of switch on the market which will handle High Potential Currents without *Arc, Spark, or Danger.* The fundamental principle of these switches is a break in a Special Colorless, Odorless and Acidless Oil, possessing the highest possible insulating qualities.

The switches are of the plunger type, the number of plugs being proportional to the voltage.

In the construction of our switches the danger of arcing upon breaking the current is absolutely eliminated by the valve arrangement, which is so constructed that the oil, acting by suction, prevents the formation of an arc at the instant the current is broken.

We have just completed a large number of these switches for the New Armour Switch Board at Chicago. Catalogue, prices and further information will be furnished upon application.

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Hart H. & H. Push Switch.

No. 701 Single Pole.
No. 702 Double Pole.
No. 703 3-way.
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"A fine piece of workmanship and I shall take pleasure in recommending it to all requiring a first-class switch."

This is the opinion of one of our most prominent electrical engineers.

It will pay you to specify "Hart H. & H." Push Switch when next ordering.

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1,000,000 sold during the past 12 months.

Mesco Dry Battery.

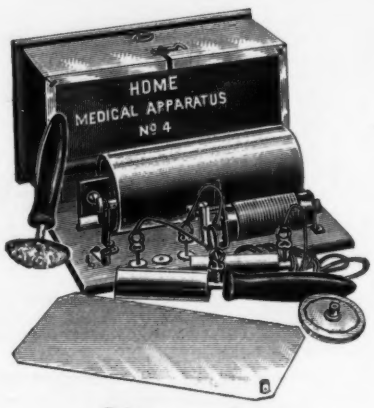
Acknowledged the Best Dry Cell Manufactured.

Price, each, 40c.

Standard size, 2½x6½.
We make all sizes.

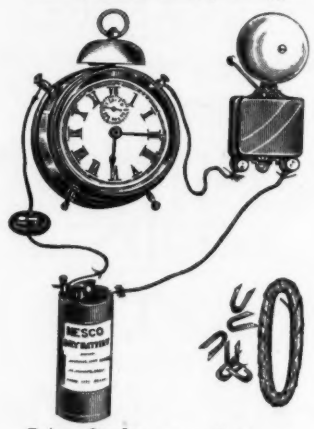
Battery Zincs.

We have purchased the plant of the Carr Metal Company and can furnish the Carr composite zincs in all forms and quality heretofore supplied by that company.



Price.....$4.50.
We make a number of different styles.

Alarm Clock Outfit, No. 1½.



Price, Outfit.....$3.75.
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Dittmar Pocket Battery Gauge.

Will register the strength of open or closed circuit batteries.

Price, each, $3.50.

Desk Telephone Outfit. No. 11.

Price.....$9.00.

We make a dozen different Telephone Outfits.

Telephone Outfit. No. 14.

With our high-grade carbon transmitter, which will be sent on approval to responsible parties.

Price, with 2 cells Mesco Dry Battery, $7.50.

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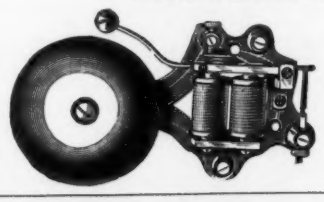
Pony Telephone Receiver.

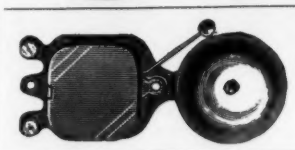
Retail price, 90 cents.

Pivoted Armature Bells.



Finely Finished Cast Gongs.

All sizes.



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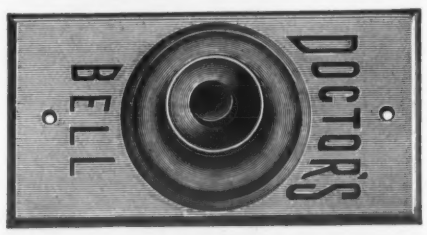
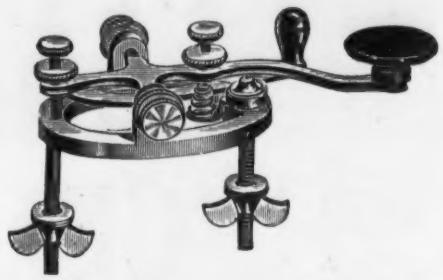
Special Prices.

Table Clamp (with push button).

Price, nickel plated...85c.
Silk covered cord, per yard, extra .....15c.



Over 100 Styles of Metal Push Buttons.



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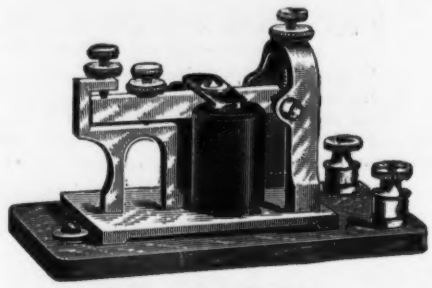

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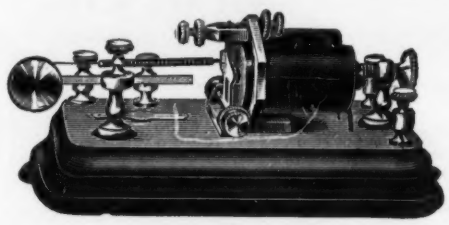
Aluminum or Brass Lever.
Price, 5 ohms, each, $2.25.
" 20 " " 2.50.

We make a full line of Telegraph instruments.



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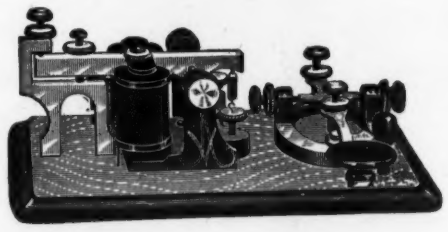
150 Ohms, $7.00.



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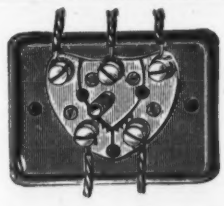
Instruments only, $1.75.



Union Lightning Arrester (with plug).

Nickel plated .....75c.

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STYLE U.
Size 1¾x4.
Voltage 1.55.
Amperage 3 to 5.

VOLTAMP DRY CELLS.

NON-POLARIZING. HIGH VOLTAGE.
LOW RESISTANCE. QUICK RECOVERY.
FREE FROM ALL LOCAL OR CHEMICAL ACTION.

The finished cells, when ready for the market, are encased in what is known as our "Guarantee Shell."

Should any cell fail to develop a current sufficient to ring an electric bell one year from the date stamped on the margin of case (which is the date the cells were sold by us to the dealer), a fresh cell will be supplied on application.

NO MANUFACTURER HAS HERETOFORE DARED TO MAKE SUCH A GUARANTEE

ONLY FIRST CLASS MATERIALS ENTER INTO OUR CELLS.

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UNEQUALLED FOR

TELEPHONES

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Used Exclusively by U. S. Signal Corps and Pullman Palace Car Co.

Polarization reduced to a minimum. Unaffected by heat or cold. High voltage and amperage. Great recuperative power. Longest Life. Compact. Full strength.

BEWARE OF IMITATIONS.

Other Manufacturers Endeavor to Imitate the Shape but Cannot Approach the Quality.

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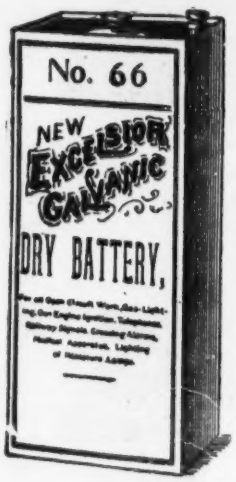

POSITIVELY NO POLARIZATION.

...FOR...

ORDINARY CAUTERY,
GAS ENGINES,
RAILROAD ALARMS,
CROSSING SIGNALS,
TELEPHONES,
MEDICAL APPARATUS,
SURGICAL INSTRUMENTS,
HOUSE BELLS (2 years),
MINIATURE LAMPS (100 hours steady),
BURGLAR ALARMS and
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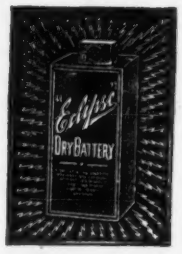

The Best Dry Battery in the World.

Voltage, 1.55 to 1.6; Amperes, about 15; Dimensions, 2¼ x 2¾ x 6 ins. List price, $1.00.

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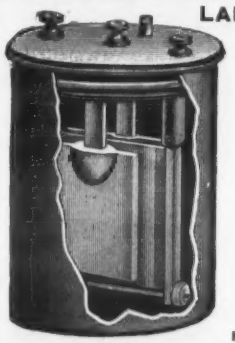
NEW EXCELSIOR DRY BATTERY CO., 661-663 HUDSON ST., N. Y.

FOR AUTOMOBILES

AND GASOLINE LAUNCHES

USE THE EDISON LALANDE BATTERIES.



LIGHT WEIGHT AND LIQUID TIGHT.

CONSTANT CURRENT AND NO WASTE WHEN IDLE.

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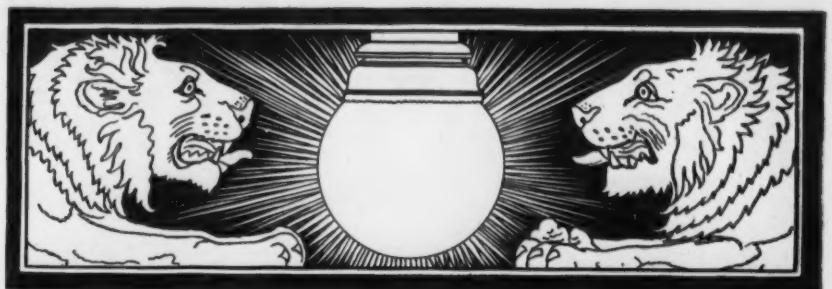

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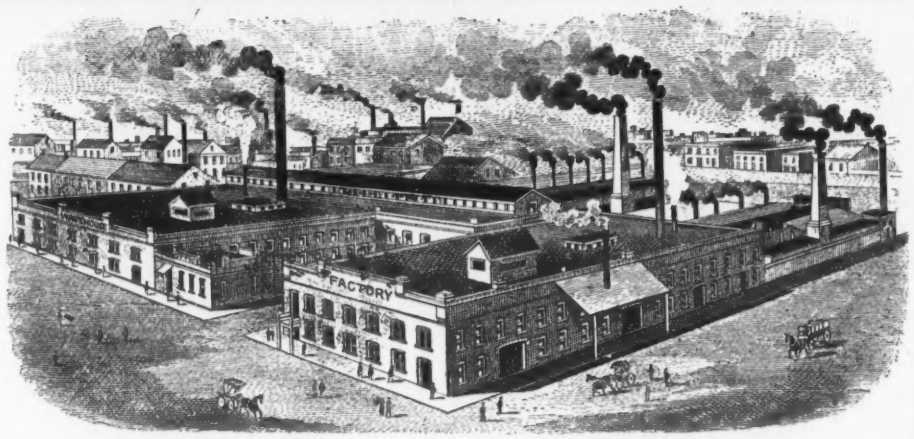

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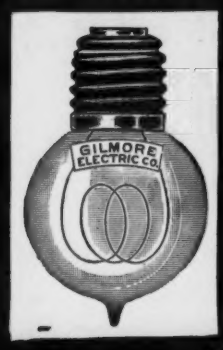

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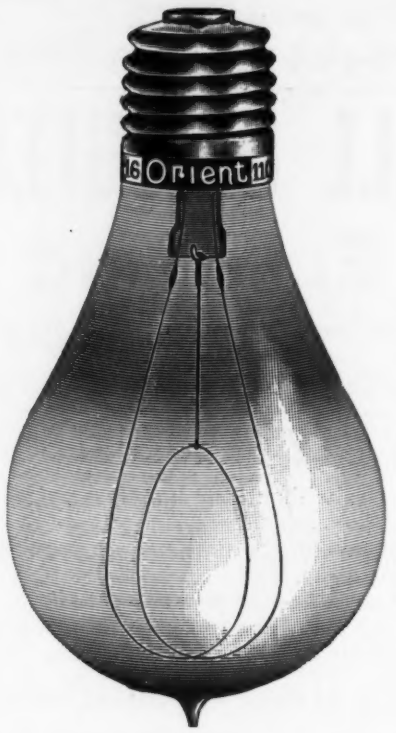

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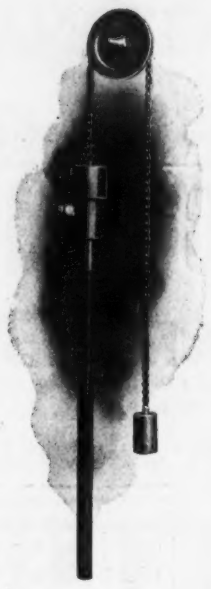

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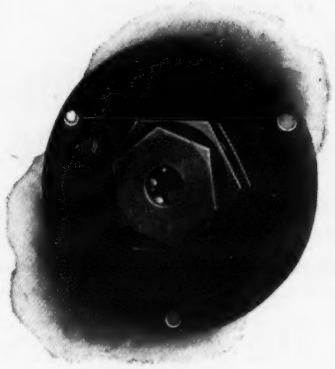

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has no sliding contacts;
has no springs;
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has nothing to get out of order;
trims as easily as an open arc;
burns a long time;
is not expensive in first cost;
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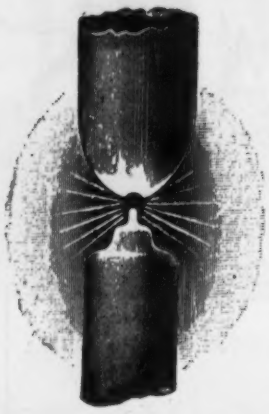

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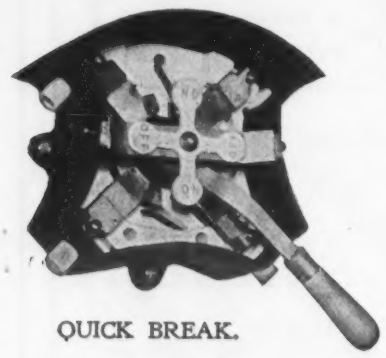

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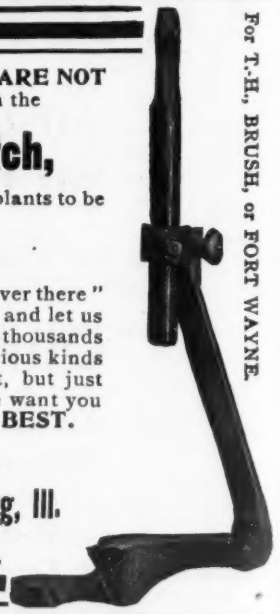

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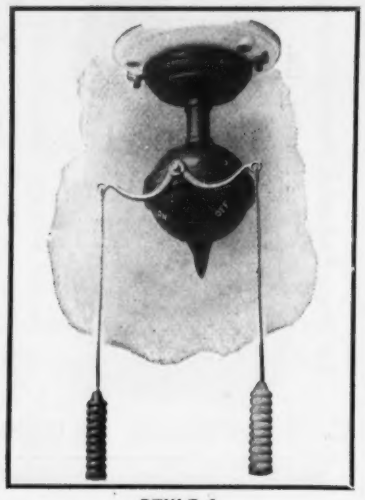

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A beautiful as well as useful device for interior arc lighting.

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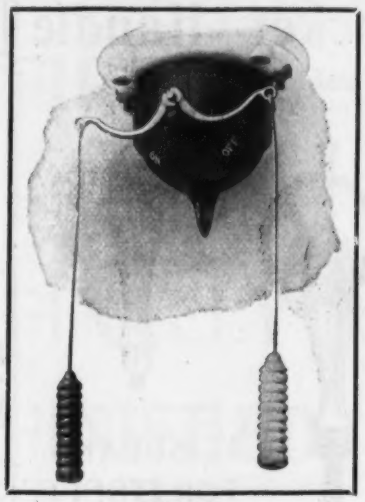

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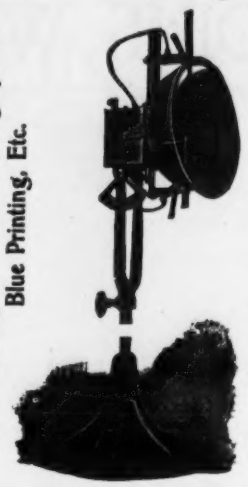

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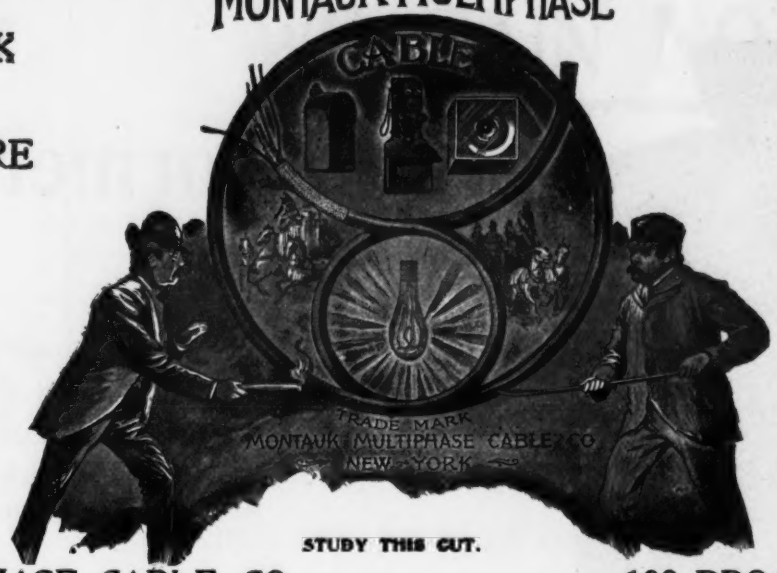

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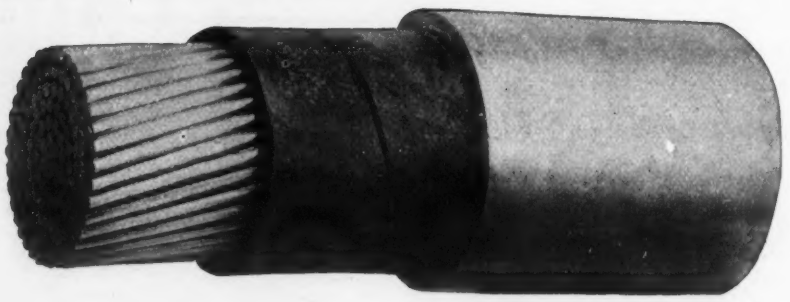

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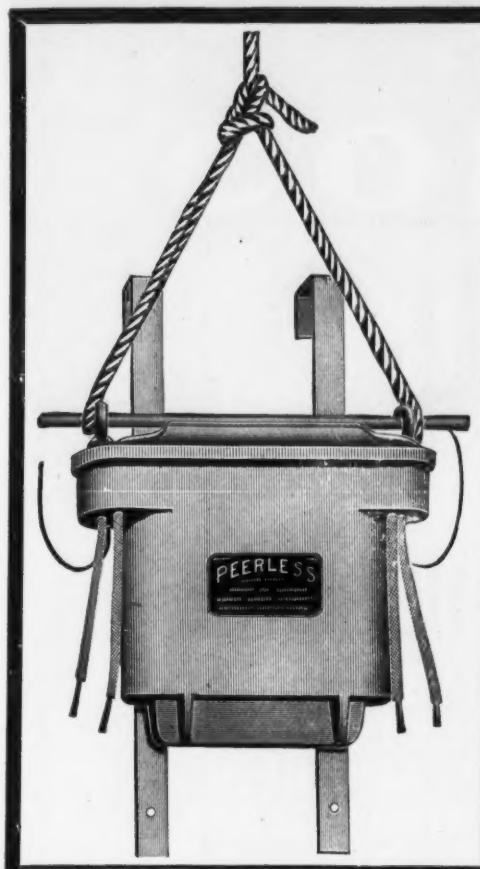

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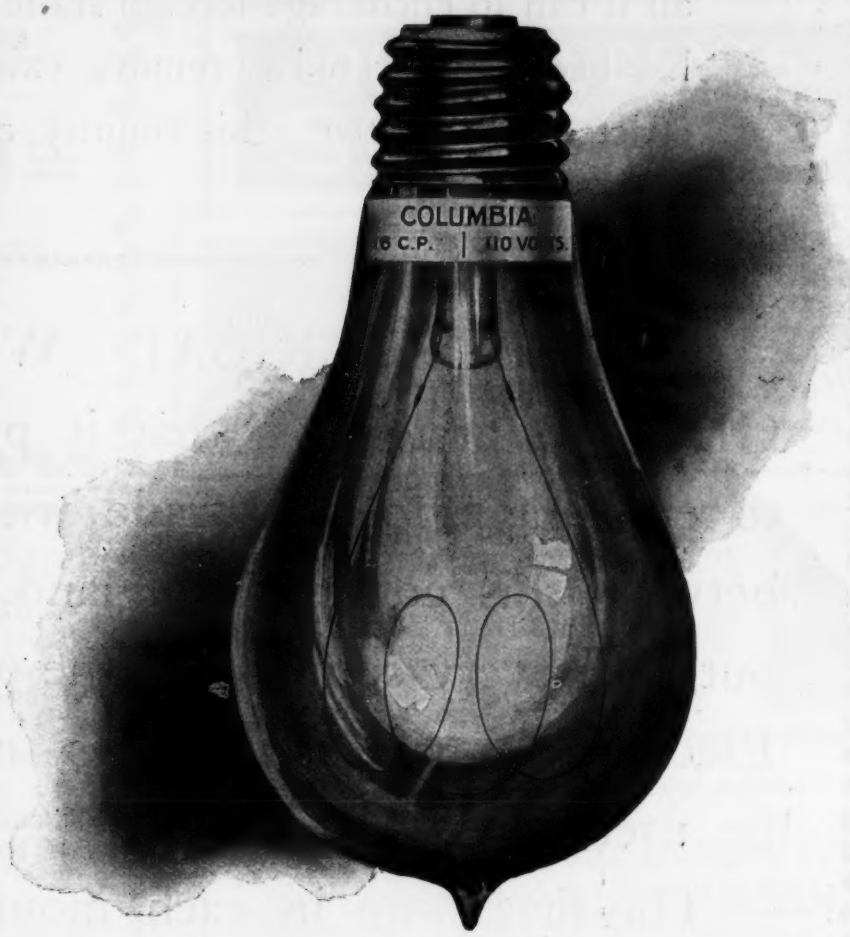

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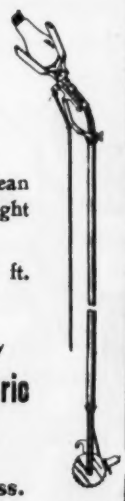

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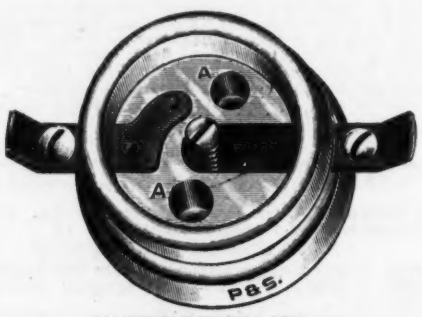

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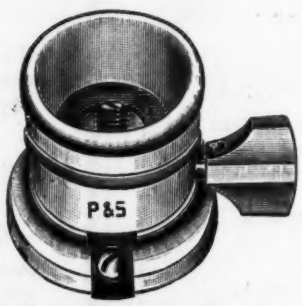

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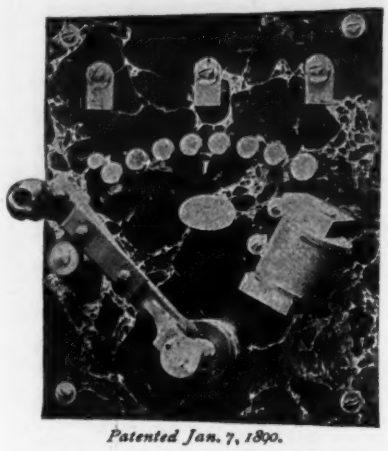

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ALPHABETICAL INDEX TO ADVERTISERS.

Aaron Electric Co. 51
Adams-Bagnall Electric Co. 12
Advance Specialty Co. 3
Allington & Curtis Co. 47
American Battery Co. 47
American Bell Telephone Co. 54
American Commercial Rubber Co. 2
American Electrical Heater Co. 25
American Electric Specialty Co. 4
American Electric Telephone Co. 54
American Electric Heating Corp. 8
American Electrical Works 47
American Endoscopic Co. ....
American Engine Co. 63
American Fire Engine Co. 64
American Hard Rubber Co. 56
American Reflector & Lighting Co. 25
American School of Correspondence 21
American Steel & Wire Co. ....
American Vitrified Conduit Co. 2
Anderson Mfg. Co., A. & J. M. 9
Arnold Electric Power Station Co. 53
Ashcroft Mfg. Co. 57
Audel & Co., Theo. 52
Audit Co. of New York, The 50
Aultman Co., The 68
Automatic Switch Co. 25

Bacon Air Lift Co. 61
Badt-Goltz Eng'g Co. ....52 and 53
Baillard, E. V. 4
Baker & Co. 3
Baker & Fox 9
Ball Engine Co. 69
Barnes Co., The Wallace ....
Barnes Co., W. F. & John 68
Barnett & Co., G. & H. ....
Becken, A. C. ....
Belden-Larwill Electric & Mfg. Co. 11
Belknap Motor Co. 59
Berlin Iron Bridge Co. 66
Bernard Co., The E. G. ....
Besly & Co., Charles H. 72
Bickford Drill & Tool Co. 69
Biddle, James G. ....
Bliss Co., E. W. 67
Bogart Co., A. L. 3
Bogue, Charles J. 14
Bossert Electric Const. Co. 34
Bowsher Co., N. P. ....
Brady, T. H. 14
Bristol Company, The 1
Brooklyn Wharf & Warehouse Co. 50
Bryan, Richard R. 53
Bryan & Humphrey 53
Bryant Electric Co., The 47
Buckeye Electric Co. 2
Buckeye Electric Repair Works 47
Bullock Electric Mfg. Co. 59
Bullock Mfg. Co., M. C. 67
Burnley Battery & Mfg. Co. ....
Burt Mfg. Co. ....

C & C Electric Co. 59
Capital Electric Co., The 13
Carlisle & Finch Co. 5
Carpenter Die & Tap Co., J. M. 72
Cary Spring Works 34
Case Mfg. Co. 67
Central Electric Co. 27
Central Mfg. Co. 14
Central Telephone & Electric Co. 56
Chase-Shawmut Co. 29
Chicago Belting Co. 72
Chicago Edison Repair Works 50
Chicago Fuse Wire & Mfg. Co. 52
Chicago General Fixture Co. ....
Chicago Insulated Wire Co. ....
Chicago Rheostat Co. 34
Cincinnati Milling Machine Co. 70
Cleveland Armature Works 51
Cleveland Flue Cleaner Mfg. Co. ....
Columbia Incandescent Lamp Co. 19
Columbian Elec. Car L't'g & Brake Co. 60
Colwell Lead Co. 1
Commercial Electric Co. ....
Conn. Telephone & Electric Co. 55
Conover Mfg. Co. 64
Consolidated Safety Valve Co. 65
Cornell Machine Co. 65
Crane Co. 65
Creaghead Engineering Co. 14
Crocker-Wheeler Co. 72
Crouse-Hinds Electric Co. 27
Crosby Steam Gage & Valve Co. 25
Croselmire, C. F. 2
Cutler-Hammer Mfg. Co. 23
Cutter Co., George 72
Cutter Co., The 30
Cutter Electrical & Mfg. Co. 1

Dayton Electrical Mfg. Co. 60
Dayton Fan & Motor Co. ....
Dayton Globe Iron Works Co. 32
Dearborn Drug & Chemical Works 63
Delaware Hard Fibre Co. 72
Diamond Meter Co. 4
Directory of Engineers 53
Dixon Crucible Co., Jos. 4
Dyer, Edmonds & Dyer 47

Eagle Paint & Varnish Works 32
Eames Co., G. T. 70
Eastern Electric Cable Co. 47
Eccleston Lumber Co. 14
Eck Dynamo & Motor Works ....
Eddy Electric Mfg. Co. 57
Edison Dec. & Min. Lamp Dept. 34
Edison Mfg. Co. 8
Edwards & Co. 34
Elbridge Electrical Mfg. Co. 64
Electric Appliance Co. 34
Electric Axle Light & Power Co. 2
Electric Motor & Equipment Co. 3
Electric Storage Battery Co. 3
Electric Vehicle Co. 70
Electrical Engineer Inst. of Cor. Inst. 47
Electro Dynamic Co. 60
Elwell-Parker Electric Co., The 60
Emerson Electric Mfg. Co. 2
Empire China Works 47
Empire Electrical Instrument Co. 1
Engineers, Directory of 53
Engineer Publishing Co. 48
Ericsson Telephone Co. 1
Eyanson & Armpriester ....

Fagan, J. C. ....
Falk Company, The 6
Faries Mfg. Co. 13
Farr Tel. & Construction Supply Co. ....
Federal Battery Co. 3
Felton & Guilleaume 14
Ferracute Machine Co. 68
Field & Everett 53
Forest City Electric Works 2
Frick Co. ....
Frink, I. P. 25
Ft. Wayne Electric Works 13
Fuller, John E. 60

Galvanic Metal Paper Co. 65
Garlock Packing Co. 25
Garton-Daniels Co. 26
Garvin Machine Co. 68
General Electric Co. 16
General Equipment Co. 15
Gen. Incandescent Arc Light Co. 13
Gilmore Electric Co. 10
Globe-Wernicke Co. ....
Gold Street Car Heating Co. 14
Gordon Battery Co. 9
Goubert Mfg. Co., The 67
Green Fuel Economizer Co. 62
Gregory Electric Co. ....48 and 49
Guarantee Electric Co. 51

Hadaway Electric Heating & Eng'g Co. 33
Hammacher, Schlemmer & Co. 56
Hardy Lamp Company 4
Harrington & King Perforating Co. 72
Harrington, Son & Co., Ed. 68
Harrisburg Foundry & Machine Wks. 65
Hart & Hegeman Mfg. Co., The 6
Hartford Steam Boiler Inspection & Insurance Co. 67
Hart Mfg. Co. 72
Harvard Electric Co. 56
Hayden & Derby Mfg. Co., The ....
Hays Construction Co. 61
Hazard Mfg. Co. ....
Heald & Son, L. S. 68
Heine Safety Boiler Co. 65
Herrick, A. B. 53
Hobart Electric Mfg. Co. 60
Hochhausen, H. T. 51
Hoffman, George W. 48
Holmes Fibre-Graphite Mfg. Co. ....
Holophane Glass Co. 13
Holtzer-Cabot Electric Co. ....
Homer & Co., F. L. 55
Horry, William Smith 53
Houston & Kennelly 53
Huebel & Manger 17
Huebsch & Co., D. A. 14
Hunt Co., C. W. 67
Hunter Machine Co., James ....

Ide & Sons, A. L. ....
Illinois Electric Co. ....
Illinois Insulated Wire Co. 17
Incandescent Elec. Light Manipulator Co. 21
Indiana Rubber & Ins. Wire Co. 1
India Rubber & G. P. Ins. Co. 23
Insulating Saddle Staple Co. ....
International Correspondence Schools 21
International Electric Co. 3
Iron Clad Resistance Co. 3

Jackson, J. P. ....
Jandus Electric Co. ....
Jeffrey Mfg. Co., The 68
Jenkins Bros. 1
Jenney Electric Mfg. Co. 50
Jessop & Sons, Ltd., William 68
Jewell Electrical Inst. Co. 26
Johns Mfg. Co., H. W. 3
Johnson & Morton 13
Johnston, Thomas J. 53
Jones & Son Co., J., The 3

K. & W. Company 12
Kartavert Mfg. Co. ....
Kelley & Son, Beni. F. 67
Kester Electric Mfg. Co. 52
Keuffel & Esser Co. ....
Keystone Electric Telephone Co. 55
Keystone Electrical Instrument Co. 25
Kinsman, Frank E. 52
Klein & Son, Mathias 14
Klipstein & Co., A. ....
Knapp Electric & Novelty Co. 27
Kokomo Telephone & Elect. Mfg. Co. ....
Kosmic Oil Filter Co. 70

LaKon Co., The 21
La Roche & Co., F. A. ....
Lea Manufacturing Co. 12
Leather Preserver Mfg. Corp. 52
Leclanche Battery Co. 3
Leffel & Co., James ....32 and 64
Lincoln Electric Co. 59
Link Belt Engineering Co. 68
Liverpool & London & Globe Ins. Co. 14
Locke, Fred M. 25
Lombard Water Wheel Gov. Co. 47
Long & Allstatter Co., The 70
Lunkenheimer Co., The 64
Lynn Incandescent Lamp Co. 3
Littlefield & Kennedy 51

McCay Engineering Co. 17
McGowan Co., The John H. 67
McIntire Co., The C. 3
McIntosh, Seymour & Co. 63
McLennan & Co., K. 48
Machado & Roller 25
Magers, J. B. 14
Maintenance Co., The 59
Main Belting Co. 62
Manhattan Electrical Supply Co. 7
Manhattan General Const. Co. 10
Manross, F. N. 3
Marshall, Wm. 72
Martinez, H. 2
Mason Tele. Pay Station Co., The 56
Mayer Electric Co., Maxwell M. ....
Meyrowitz, E. B. 25
Mica Insulator Co. 34
Michigan Electric Co. 15
Michigan Pipe Co. ....
Mietz, A. 64
Monson-Burmah Slate Co. ....
Montauk Multiphase Cable Co. 15
Moore, A. F. 1
Munsell & Co., Eugene 34

National Carbon Co. 12
National Conduit & Cable Co. 1
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New Britain Machine Co., The 64
New England Butt Co. 62
New Excelsior Dry Battery Co. 8
New Process Raw Hide Co., The 64
New York & Ohio Co. 1
New York Central R. R. 50
New York Insulated Wire Co. 1
New York Telephone Co. 52
Non-Polarizing Dry Battery Co. 8
North Electric Co. 55
Northern Electrical Mfg. Co. 33
Northwestern Telephone Mfg. Co. 54
Norton Electrical Inst. Co. 25

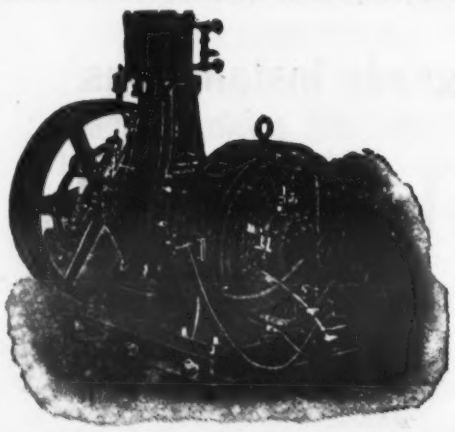
Okonite Co., Ltd., The 1
Onondago Dynamo Co. 60
Onota Manufacturing Co., The 20
Orient Electrical Co., The 11
Osterberg & Sutton 53
Ostrander & Co., W. R. 72

Pacific Electric Co. 9
Packard, G. F. 53
Paiste Co., H. T. 4
Parsell & Weed 52
Pass & Seymour 22
Payne Co., Inc. 64
Pelton Engineering Co. ....52 and 53
Pelton Water Wheel Co. 33
Pepper & Register 53
Peru Electric Mfg. Co. 15
Peterson & Co., John L. 12
Pettingell Andrews Co. 32
Phelan, D. W. 14
Philadelphia Book Co. 52
Philadelphia Elec. & Mfg. Co. 12
Philadelphia Machine Screw Works 69
Phillips Insulated Wire Co. 34
Phoenix Battery Mfg. Co. 12
Phoenix Electric Telephone Co. ....
Phoenix Glass Co. 1
Phosphor-Bronze Smelting Co. 64
Pittsburg Glass Co. 51
Pittsburg Transformer Co. 16
Potter & Benson 53
Potter Co., F. D. 64
Powers Co., E. L., The 53
Pratt & Whitney Co. 69
Pratt Chuck Co. 69
Preston, Cohen & Co. 26
Priestman & Co. 64
Prindle Pump Co. 62
Pringle, W. T. ....
Proposals ....48 to 52
Providence Gas Burner Co. 2

Queen & Co., Inc. 4
Quimby, William E. 69

Rawson Electric Co. 54
Reckenzaun, Fred'k 53
Reid, Thorburn 53
Reisinger, Hugo 15
Reliance Lamp Electric Co. 9
Replogle Governor Works, The 33
Ridgway Dynamo & Engine Co. ....
Riker Electric Vehicle Co. 1
Riley Bros. 9
Ritchie & Sons, E. S. 72
Roberts Electric Supply Co., H. C. 26
Robbins & Myers Co., The 21
Roche, William 55
Rockwood Mfg. Co. 63
Roebling Sons' Co., J. A. 17
Rolfe Electric Co. 47
Rosenbaum, W. A. 47
Rossiter, MacGovern & Co. 49
Roth Brothers & Co. ....
Rushmore Dynamo Works 25
Russell-Tomlinson Elec. Co. 56
Ryle & Co., Wm. 72

Continued on Page 26.



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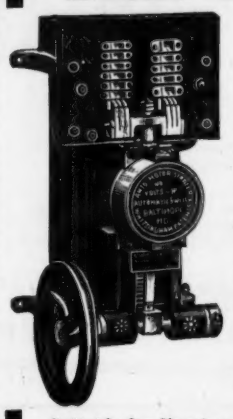

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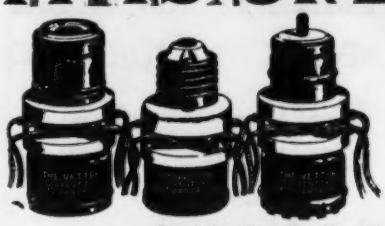

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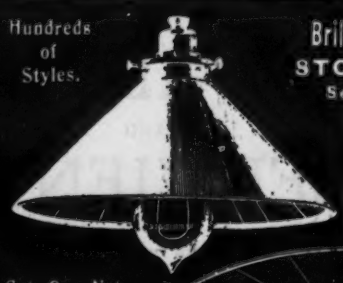
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ALPHABETICAL INDEX TO ADVERTISERS.—*Continued from Page 24.*

Sachers, Ralph Julian....47
Samson Cordage Works....34
Sargent & Lundy....53
Sawyer-Man Electric Co....
Schieren & Co., Chas. A....1
Schlicht Combustion Process Co....62
Schmidt & Bruckner Electric Co....56
Schoonmaker, A. O....2
Sebastian Lathe Co....70
S. E. I. Co....
Seneca Falls Mfg. Co....69
Sheaff & Jaastad....53
Sheehan & Co., W. M....53
Shipman & Perrine....53
Shultz Belting Co....1
Siemens & Halske Electric Co....5
Sills Mica Co., W. H....51
Simplex Electrical Co....1 and 8
Smethurst & Allen....53
Smith Co., S. Morgan....32
Speer Carbon Co., The....1
Spencer Electrical Co....
Spencer Automatic Machine Screw Co..69
Sperry, B. N....13
Splitdorf, C. F....3
Sprague Electric Co....59
Standard Paint Co., The....34
Standard Telephone & Electric Co....54
Standard Thermometer & Electric Co....9
Standard Underground Cable Co....72
Stanley Instrument Co....5
Sterling Arc Lamp Co....12
Sterling & Son, W. C....14
Sterling Electric Co....54
Sterling Varnish Co....34
Steward Mfg. Co., D. M....60
Stewart & Co., Frank H....14
Stewart Electrical Co....50
Stilwell-Bierce & Smith-Vaile Co....33
Stirling Company, The....62
Stone City Telephone Mfg. Co....
Storage Battery Supply Co....72
Storey Motor & Tool Co....
Stow Mfg. Co....69
Strock, S. C....14
Stromberg-Carlson Tele. Mfg. Co....55
Stucky, Jacob....47
Stucky & Heck....47
Sturtevant Co., The B. F....58
Smith, A. T....
Telephone Mfg. Co....54
Texas Arm & Pin Co....14
Thomas & Sons Co., R....60
Thompson, Chas. A....50
Thompson, Edward P....52
Thompson, Guion....53
Thompson, Son & Co....50
Toerring Co., C. J....28
Toomey, Frank....51
Townsend & Decker....47
Triumph Electric Co....24
Tucker Mfg. Co....56
Union Boiler Tube Cleaner Co....1
Union Hardware Co....14
Union Porcelain Works....56
United Electric Heating Co....25
United States Carbon Co., The....1
United Electric Improvement Co., The....
Utica Fire Alarm Telegraph Co....54
Valentine Clark Co....14
Van Dorn & Dutton Co....52
Varley Duplex Magnet Co....3
Varney & MacOuat....52
Viaduct Mfg. Co....54
Victor Electric Co....
Vitro-Chrome Chemical Co....2
Voltamp Electric Mfg. Co....8
Vose, Ralph....51
Vulcanized Fibre Co....32
Wagner Electric Mfg. Co....57
Wall Street Journal....21
Walsh's Sons & Co....51
Want and For Sale Ads....48 to 52
Ward Leonard Electric Co....23
Warren Electric and Specialty Co....17
Warren Elec. Mfg. Co....57
Warren-Medbury Co....60
Warren Mfg. Co....51
Watkins, F. M. ....
Watson-Stillman Co. 69
Webster Chemical Co....47
Wennstrom Co., The John....3
Western Electric Co....5
Western Electrical Supply Co....31
Westinghouse, Church, Kerr & Co....71
Westinghouse Electric & Mfg. Co....71
Westinghouse Machine Co....71
Weston Electrical Instrument Co....72
Wheeler Reflector Co....26
White Co., The O. C....2
White & Co., J. G....53
Whitney Electrical Inst. Co....21
Willyoung, Elmer G....4
Wirt & Co., Charles....2
Worstall & Co., A. M....53
Wrought Iron Bridge Co....64
York Mfg. Co....65
Yorkville Electric Construction Co....47

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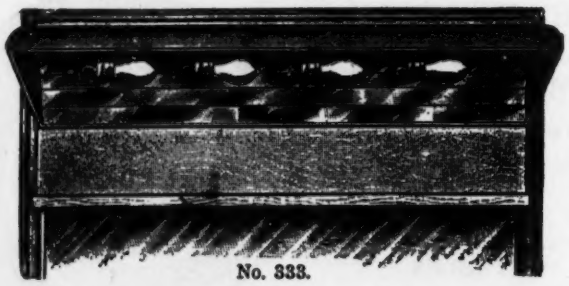
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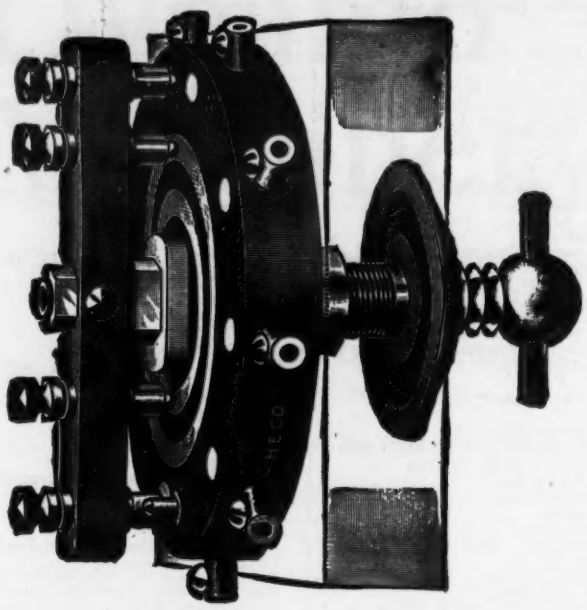

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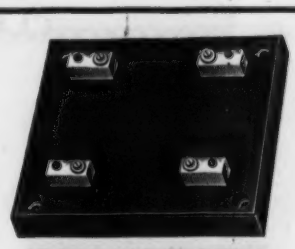

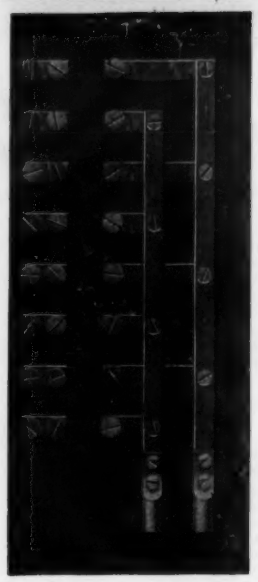

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Continued on Page 28.

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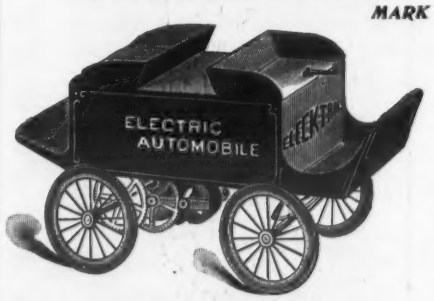

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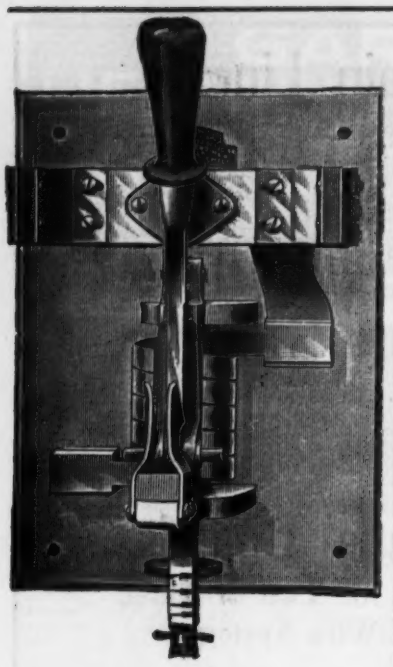

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Continued on Page 30.

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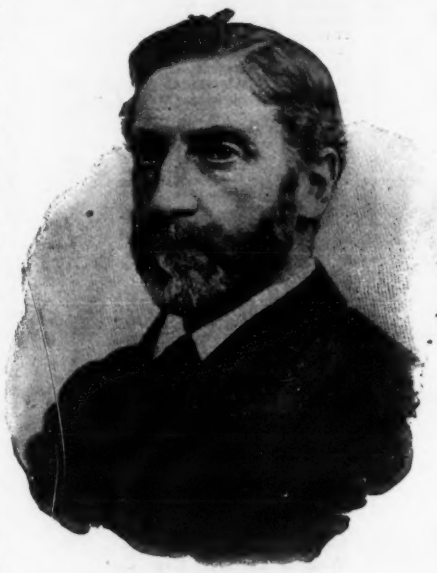

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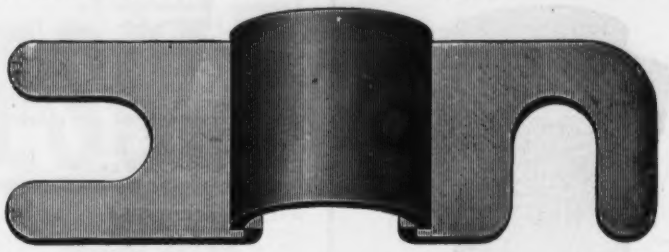

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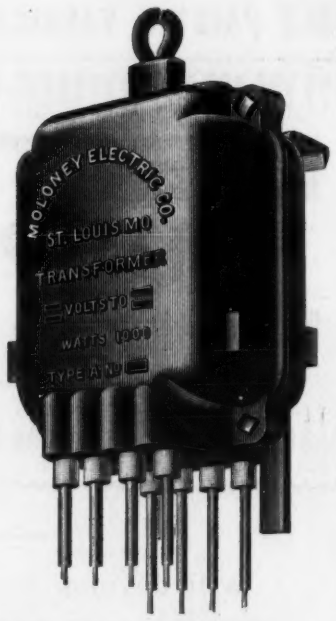

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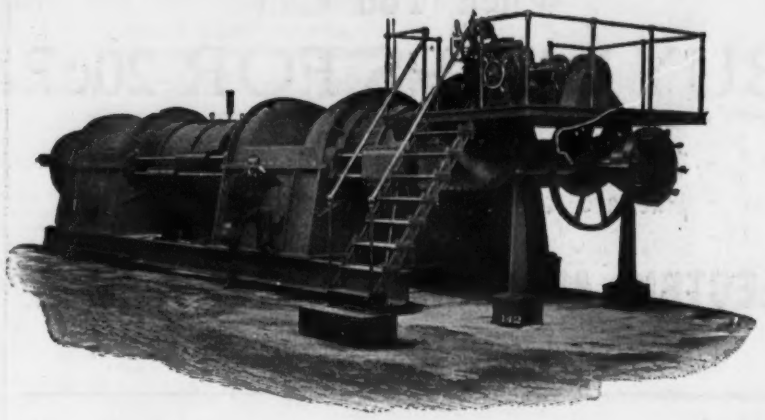

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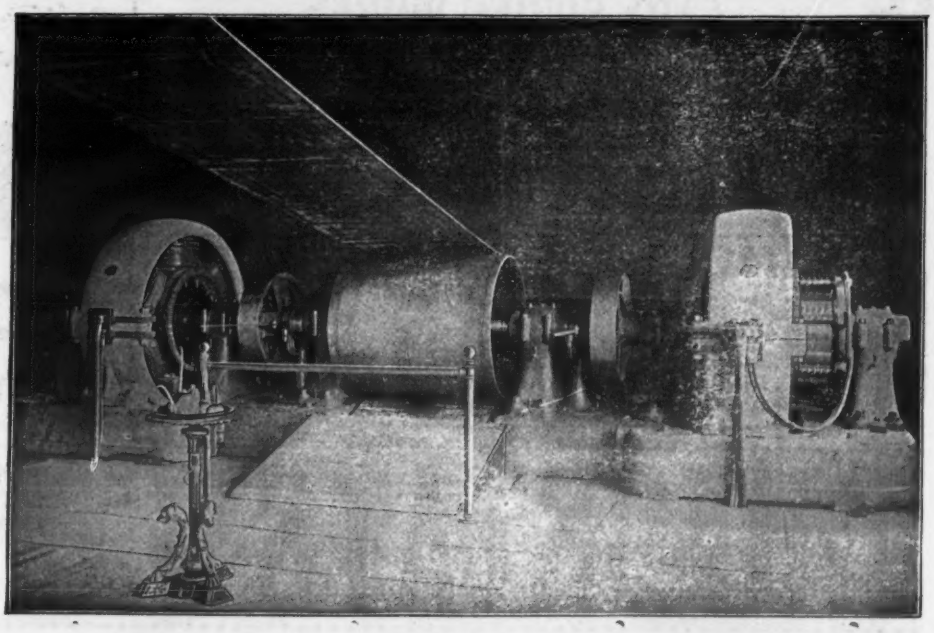

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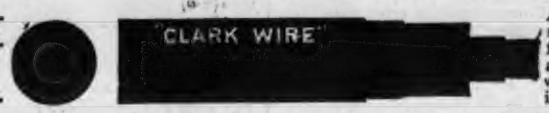

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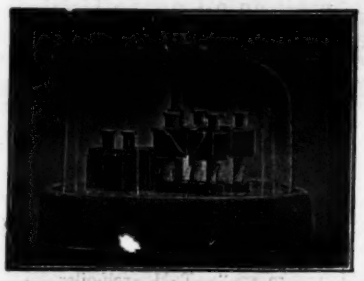

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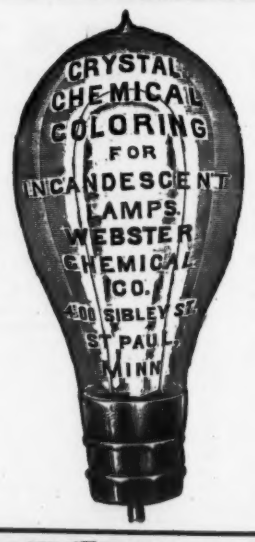

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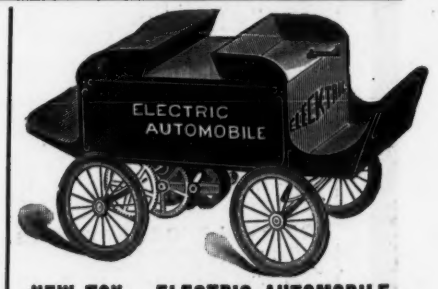

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1	150	" Keystone M. P.
1	160	" Rockford.
1	200	" American Engine Co. M. P.
1	225	" Detroit.
1	250	" Commercial, self-oiler, comp.
1	300	" Rockford.
2	320	" Eickmeyer.
1	340	" Eddy, self-oiler, compound.
2	350	" Hawkeye.
1	350	" Jenney, s. o. comp., new arm't.
1	450	" T.-H., Type H. I., comp.
1	450	" Edison, 25-kw, self-oiler.
1	500	" Kester, self-oiler, compound.
1	540	" Edison, 30-kw, oil cup.
3	540	" Edison, 30-kw, self-oiler.
1	600	" Eickmeyer.
1	800	" Rockford, s. o., new arm't.
2	800	" Edison, 45-kw, s. o., comp.
1	1350	" Waddell-Entz, 80-kw, M. P. for direct connection.

220-VOLT GENERATORS.

1	15 K. W.	Edison, self-oiler.
1	20	" C & C, self-oiler.
1	20	" Commercial, M. P., s. o.
1	75	" Wood, M. P., compound.
1	100	" Edison, new armature.

500-VOLT GENERATORS.

1	17 K. W.	Card, self-oiler.
1	20	" T.-H., D. 20, self-oiler.
1	25	" Rockford, self-oiler, new, comp., Manchester type.
1	25	" Edison, self-oiler.
1	30	" Jenney, self-oiler.
1	40	" Thomson-Houston, s. o.
2	45	" Edison, compound, s. o.
1	60	" Sprague, new arm't, s. o.
1	75	" Westinghouse, M. P., s. o.
1	80	" Crocker-Wheeler, s. o., M. P.
1	100	" Commercial, s. o., comp., M. P., new armature.
3	100	" Edison, s. o., compound.
1	500	" Gen. Elec., M. P., comp., new armature, s. o.

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1	5	" Ft. Wayne, 100 volts, 16,000 alternations, self-oiler.
1	3 H.P.	Westinghouse, 7200 alternations, any voltage, 2-phase.
1	10 "	Wagner, single-phase, 7200 alt.
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1	20	" 2000 " Western Electric.
1	25	" 2000 " T.-H., type L. 2, ring armature.
1	30	" 2000 " Western Electric.
1	30	" 2000 " Brush, No. 7.
2	35	" 2000 " T.-H., L. D. 2.
3	35	" 2000 " T.-H., L. D. 2, ring armature.
1	40	" 2000 " Western Electric.
1	45	" 1200 " T.-H., M. 12.
1	45	" 1200 " T.-H., ring armature.
3	45	" 1200 " Brush, No. 7.
1	50	" 2000 " Excelsior, brand new, latest type.
1	50	" 1200 " Standard.
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2	50	" 1200 " T.-H., L. D. 12, new ring armature, s. o.
1	50	" 2000 " T.-H., L. D. 2, ring armature.
1	60	" 2000 " Western Electric.
2	60	" 2000 " Wood, No. 8, Ft. W.
2	65	" 2000 " Brush.
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1	1	H. P. Belding.
1	1	" Jenney.
1	1	" Commercial.
1	3	" Westinghouse.
1	12	" Rockford.
1	12	" American Eng.
1	16	" Detroit.
1	20	" Rockford.
1	24	" Eddy, self-oiler.
1	25	" National.
2	25	" Hawkeye.
1	25	H.P. Jenney, s. o., new arm't.
1	30	" Edison.
1	35	" Edison, 30-kw.
3	35	" Edison, self-oiler.
1	35	" Kester, self-oiler.
1	40	" Eickmeyer.
1	60	" Rockford, self-oiler.
2	60	" Edison, 45-kw, self-oiler.

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3	1	H.P. Sprague, self-oilers.
1	1	" Edison, ¾-kw, self-oiler.
1	1	" Ahlm Edwards, new M. P. slow speed.
1	3	" C & C.
2	3	" General Electric, type I. B., slow speed, new.
1	3	" T.-H., self-oiler.
1	3	" Card, slow speed, s. o.
2	4	" Edison, 3-kw, self-oiler.
1	5	" Akron, self-oiler.
1	5	" T.-H., self-oiler.
1	5	" Sprague, self-oiler.
1	5	" C & C., self-oiler.
1	5	" General Electric.
1	7½	" Eddy, self-oiler.
1	7½	" Edison, self-oiler.
1	10	" Queen City, self-oiler.
1	15	" Card, M. P., s. o., new.
1	18	" Edison, 15-kw, self-oiler.
1	25	" C & C, s. o., new arm't.
1	25	" Commercial, M. P., s. o.
1	30	" Holtzer-Cabot.
1	60	" Edison, 45-kw, self-oiler.
1	100	" Wood, s. o., M. P.

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1	1	H. P. Westinghouse.
1	1	" Jenney, self-oiler.
1	1	" Eddy, self-oiler.
1	3	" Wagner, M. P., slow speed.
1	3	" Crocker-Wheeler, s'lw sp'd.
1	3	" Jenney.
1	4	" Eddy, self-oiler.
1	7½	" Wood, self-oiler.
1	7½	" E. & C., slow speed, M. P.
1	10	" Kester, self-oiler.
1	15	H.P. Nowotny, self-oiler.
1	18	" C & C, new armature.
1	20	" Triumph, s. o., Iron Clad.
1	20	" Card, self-oiler.
1	25	" T.-H., self-oiler.
1	25	" T.-H., D. 20, self-oiler.
1	30	" Gen. Elec., M. P., s. o.
1	30	" Rockford, self-oiler, new.
1	30	" Edison, 25-kw, self-oiler.
1	35	" Jenney, self-oiler.
1	50	" T.-H., self-oiler.
2	60	" Edison, 45-kw, self-oilers.
1	75	" Edison, self-oiler.
1	75	" Sprague, s. o., new arm't.
1	100	" Westinghouse, M. P., s. o.
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1	750 "	Westinghouse, 1100 v., 16,000 alt., complete, with exciter.
1	750 "	Westinghouse, 2000 v., 16,000 alt., complete, with exciter, new armature.
1	750 "	Westinghouse, 1100 v., 16,000 alt., self-oiler, with exciter.
1	750 "	Westinghouse, 2000 v., 16,000 alt., self-oiler, with exciter.
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1	750 "	National, 1100 volts, 16,000 alt., self-oiler, with exciter.
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1, 11¼ Kw. multipolar, slow speed,
1, 15 Kw. multipolar General Electric.

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2, 10 h.p. Eddy M.P.
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1, 30 Kw. Belknap.
1, 25 h.p. Crocker Wheeler multipolar.
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2 3 " Edison, 250 volts.
1 8½ " Edison, 125 volts.
1 12 " Edison, any voltage, new.
1 15 " Edison, 125 volts, second-hd.
2 20 " Edison, 250 volts.
1 20 " Edison, 500 volts.
1 25 " Edison, 125 volts.
1 25 " Edison, any voltage, new.
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1 type E Westinghouse exciter.
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1 D 7½ T.-H. any voltage (class 15), new.
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1 20 " 2000 " T.-H. arc, new.
1 30 " 1200 " T.-H. arc, new.
1 30 " 2000 " T.-H. arc, new.
2 35 " 2000 " T.-H. arc, new.
2 35 " 2000 " T.-H. arc, ring, L D 2.
2 45 " 1200 " T.-H. arc, new.
2 50 " 1200 " T.-H. arc, new ball.
2 50 " 2000 " T.-H. arc, new ball.
1 50 " 2000 " T.-H. arc, new ring.
1 45 " 1200 " Brush, arc, No. 7.
1 50 " 2000 " Brush, arc, No. 7½, new.
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2 750 " No. 1 Westinghouse, new.
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7 15-light 1000-50 volts.
1 25 " 1000-50 volt.
6 75 " 1000-50 volt.

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35 10 " 1000-50 or 100 volts.
15 15 " 1000-50 or 100 volts.
8 25 " 1000-50 or 100 volts.
3 40 " 1000-50 or 100 volts.

THOMSON-HOUSTON. TYPE F OIL.

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15 12 " 1000-50 or 100 volts.
20 20-light 1000-50 or 100 volts.
25 30 " 1000-50 or 100 volts.
20 50 " 1000-50 or 100 volts.
14 90 " 1000-50 or 100 volts.
2 150 " 1000-50 or 100 volts.
7 20 " 2000-50 or 100 volts.
6 90 " 2000-50 or 100 volts.

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2 20 " 2000-50 volts.
4 20 " 1000-50 volts.
1 10 " 1000-50 volts.
1 30 " 2000-50 volts.
1 20 " 1000-50 volts.
8 30 " 1000-100 volts.
24 30 " 1000-50 volts.
6 40 " 1000-50 volts.
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1 80 " 1000-50 volts.
22 100 " 1000-50 or 100 volts.
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1 15 " 1000-100 volts.
4 20 " 2000-100 volts.
1 75 " 2000-100 volts.
1 100 " 1000-100 volts.
1 100 " 1000-50 volts.

STANLEY. TYPE C.

4 10-light 1000-50 volts.
29 15 " 1000-50 volts.
3 15 " 1000-100 volts.
1 20 " 1000-50 volts.
1 20 " 1000-100 volts.
1 75-light 100-50 volts.
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1 350 " 1000-50 volts.

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1 10-light 1000-50 or 100 volts.
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1 50 " 1000-50 or 100 volts.
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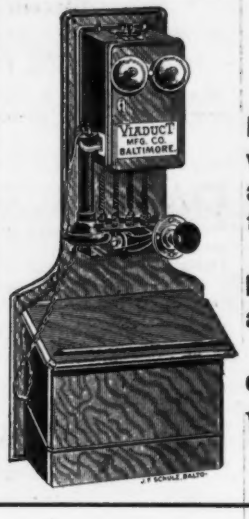

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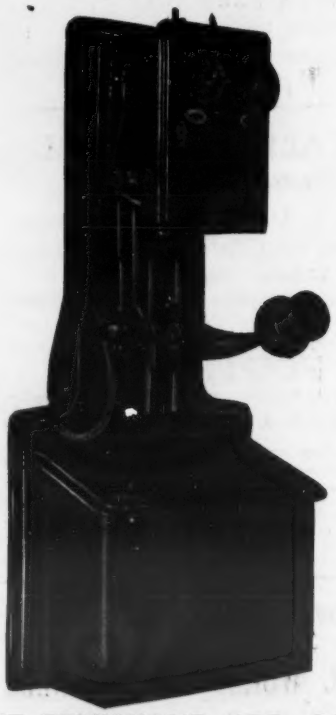

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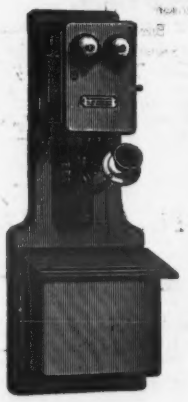

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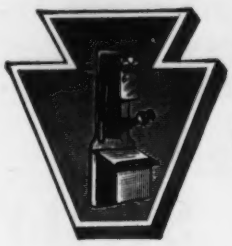

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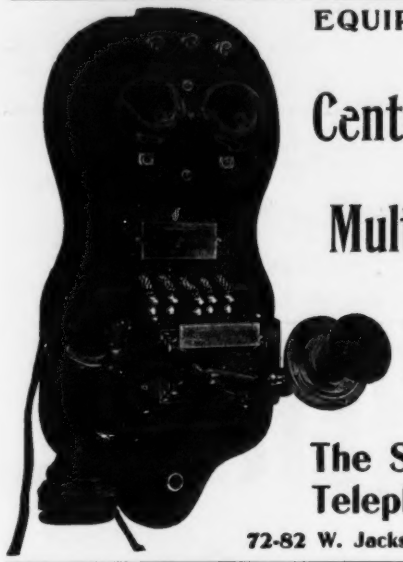

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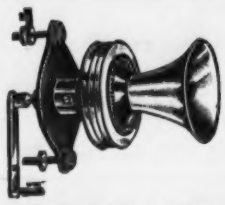

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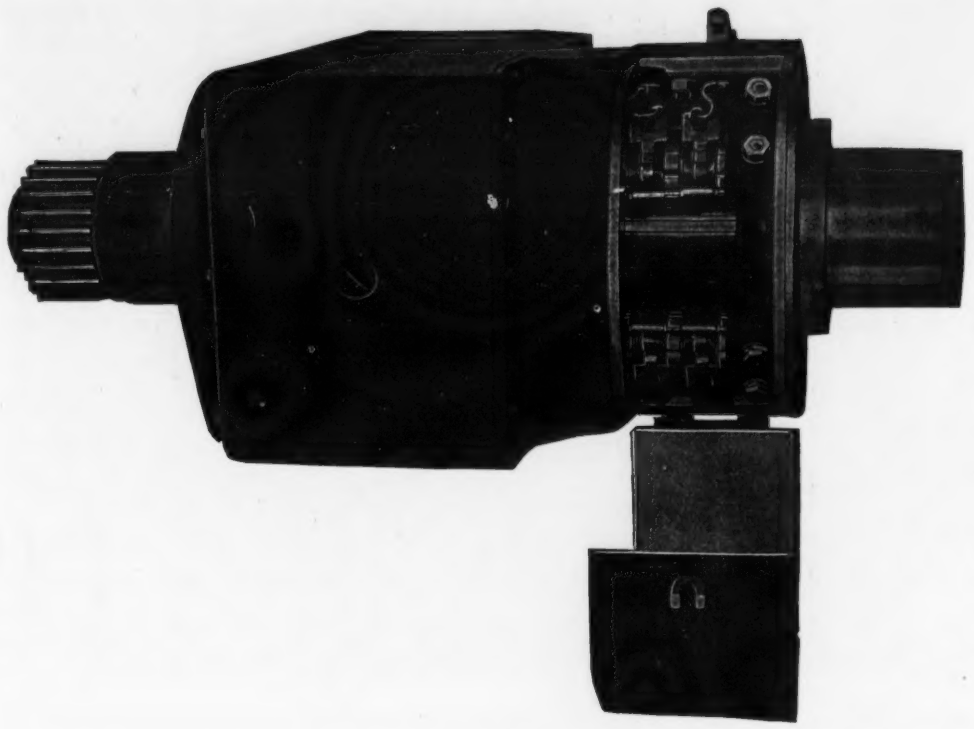

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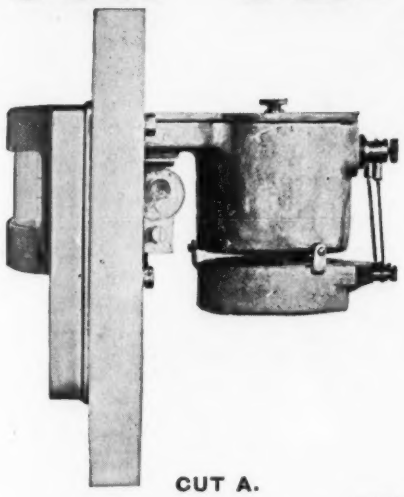

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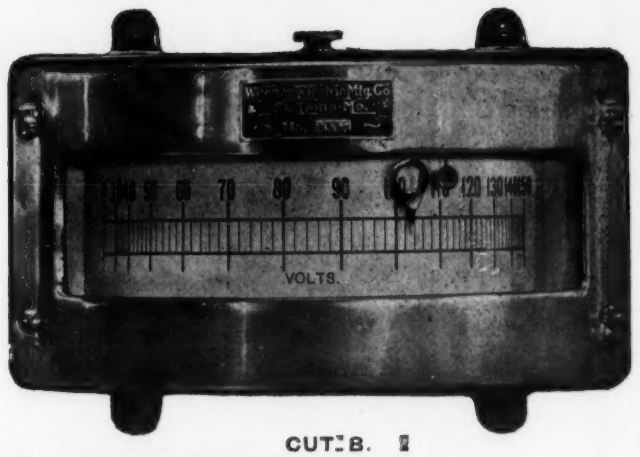

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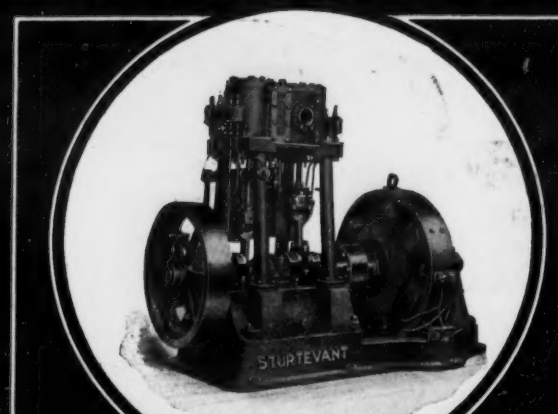

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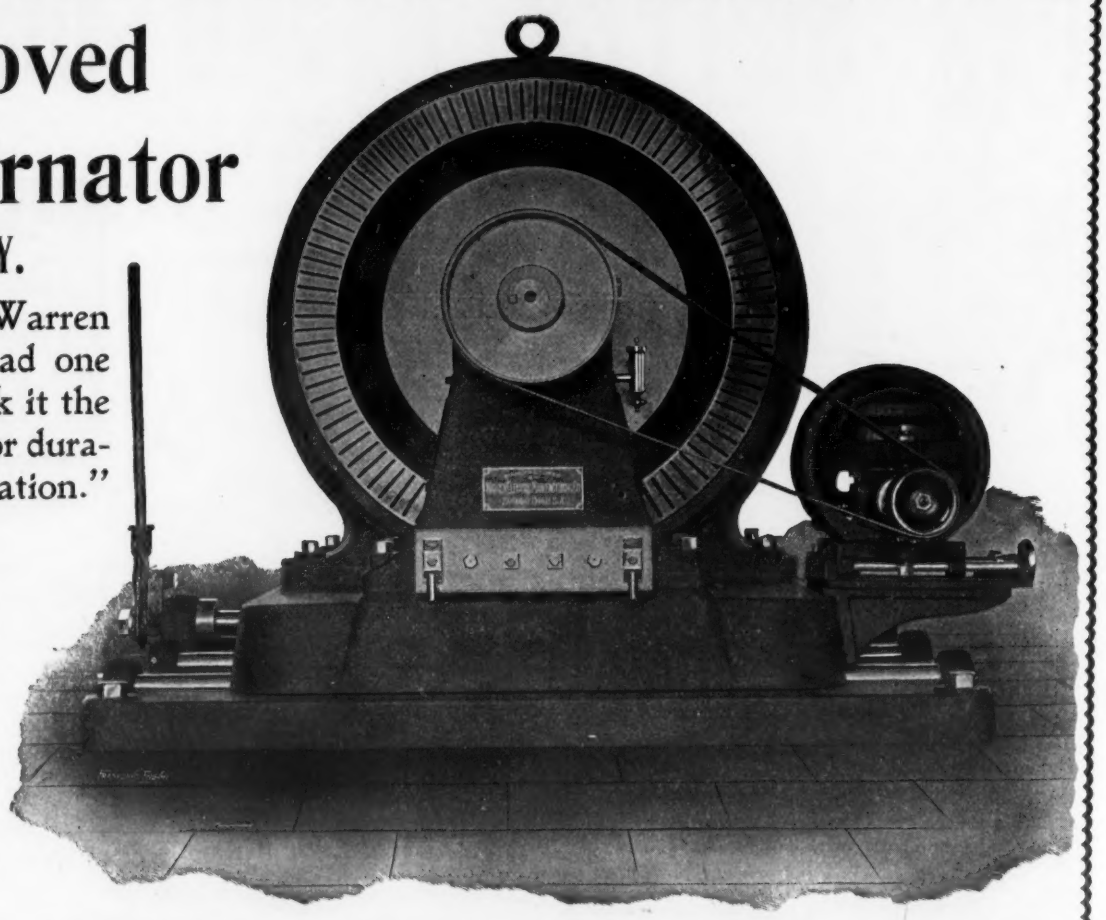

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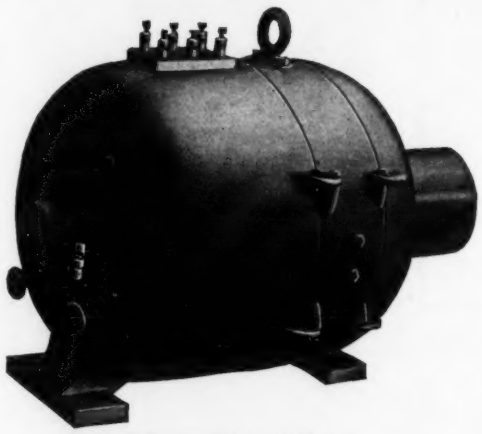

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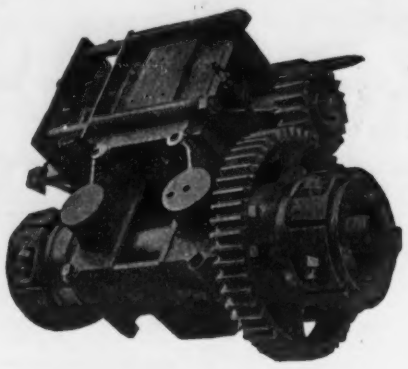

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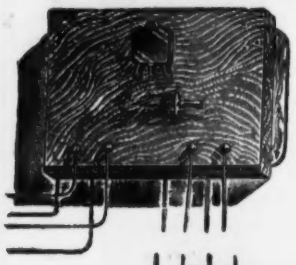

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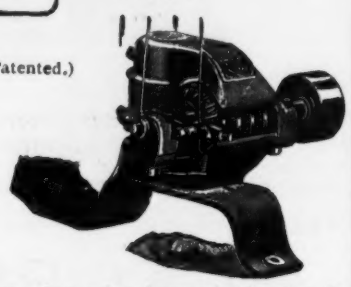

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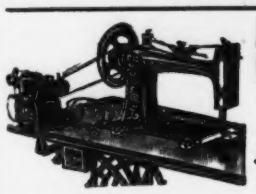

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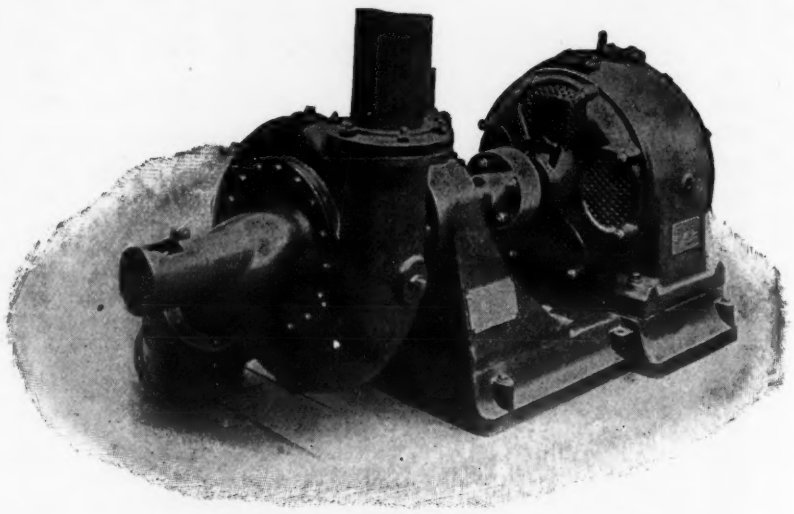

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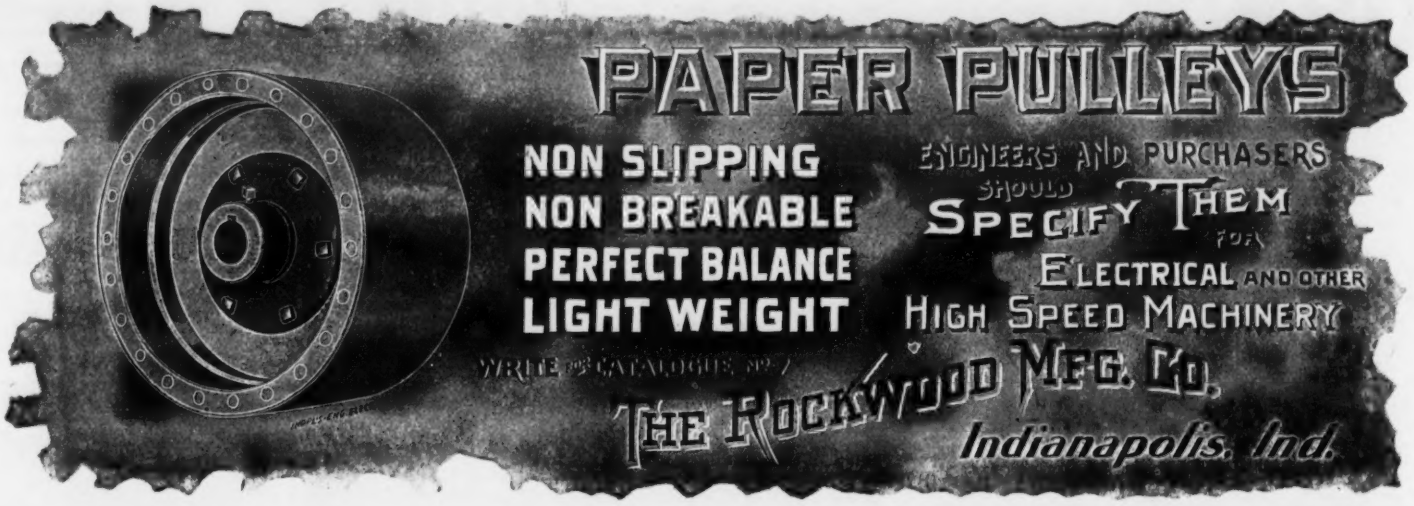

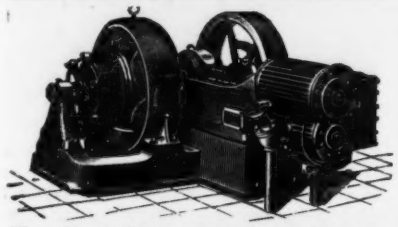

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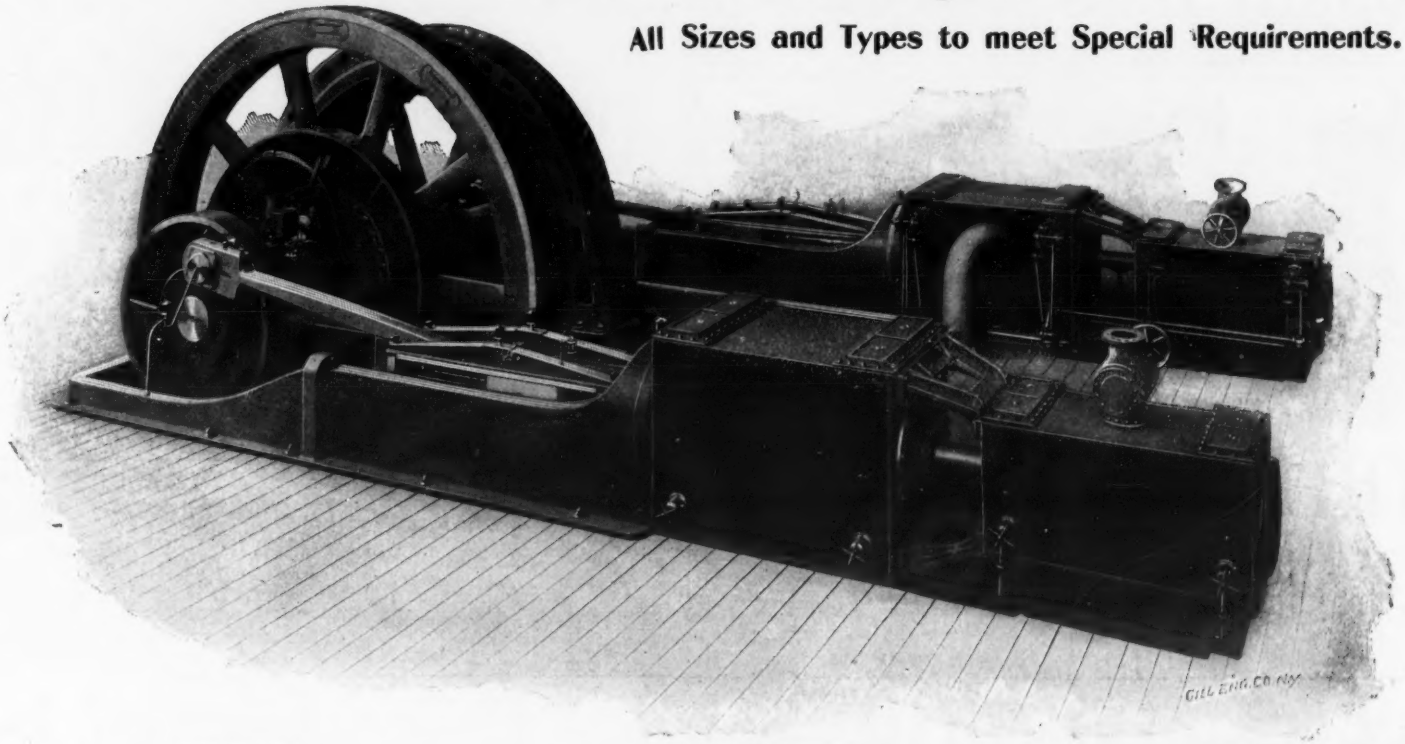

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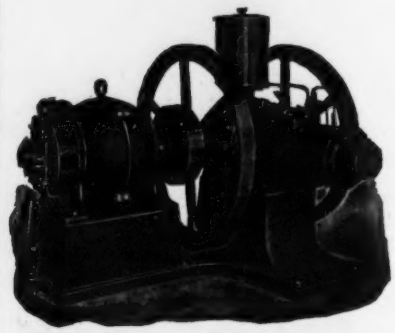
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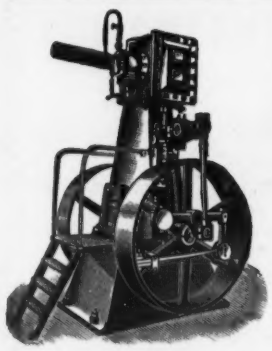
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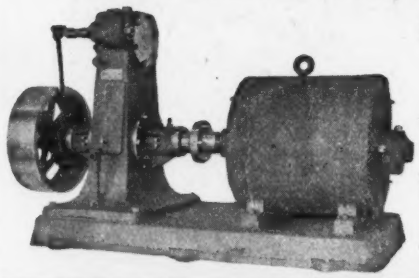
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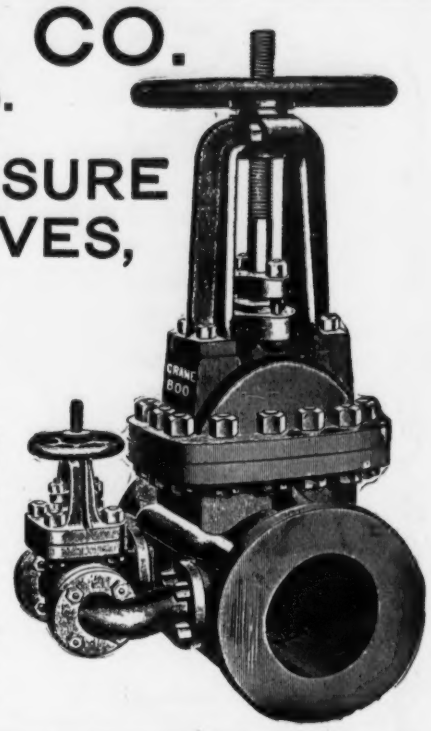

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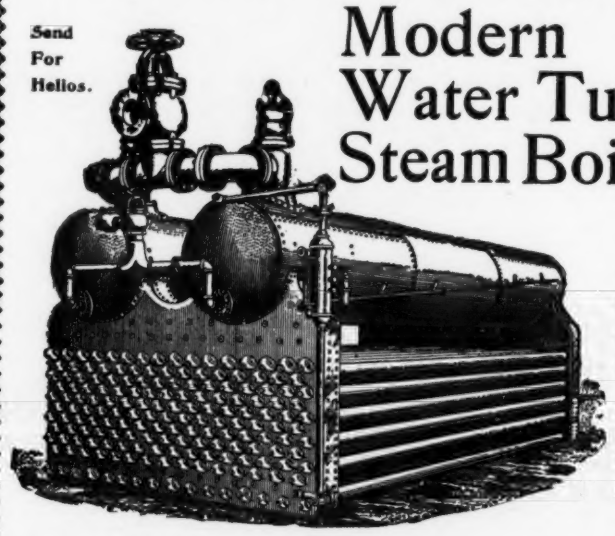

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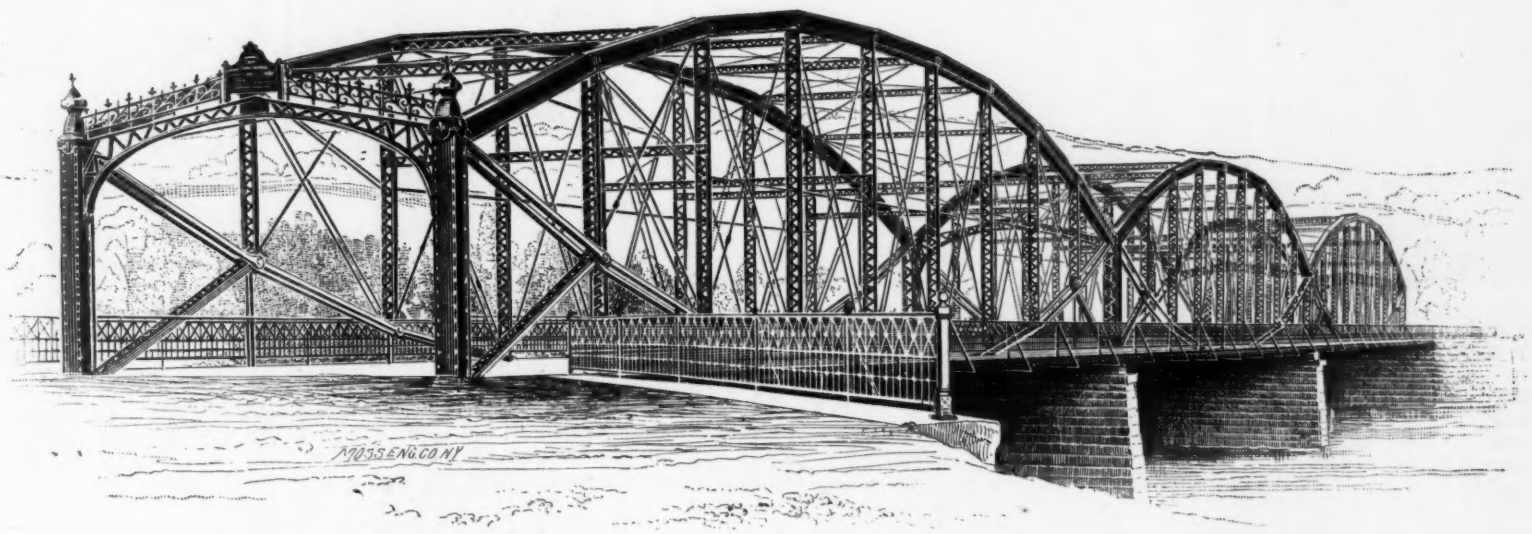

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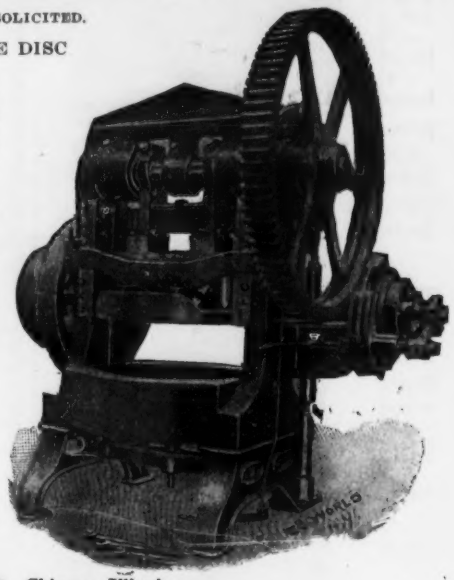

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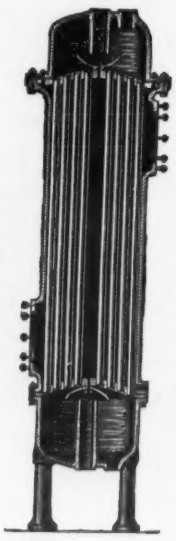

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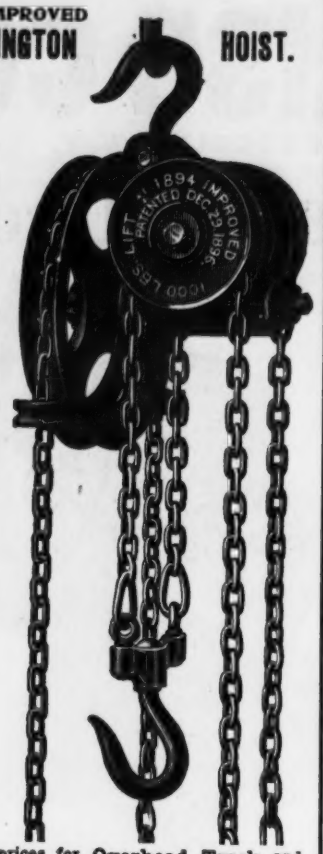

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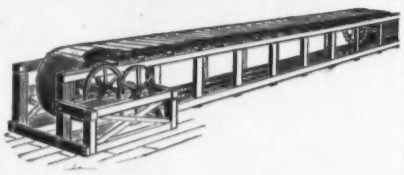

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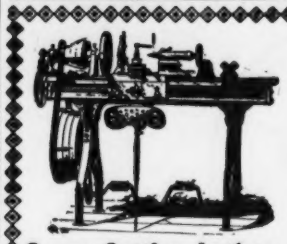

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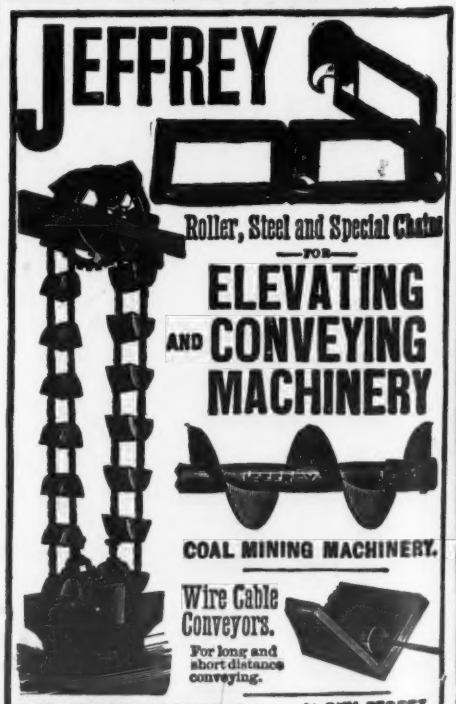

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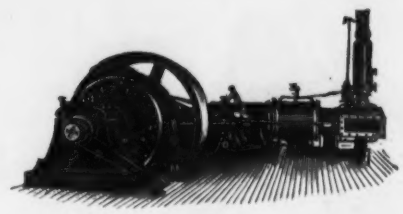

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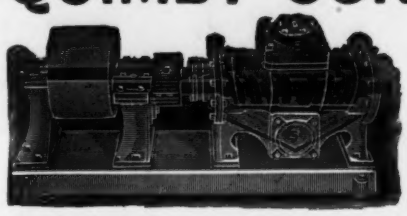

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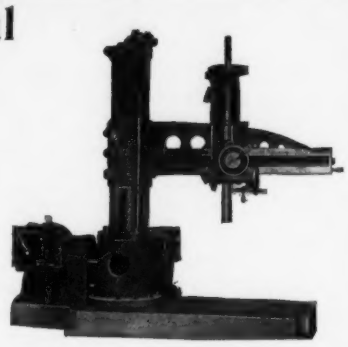

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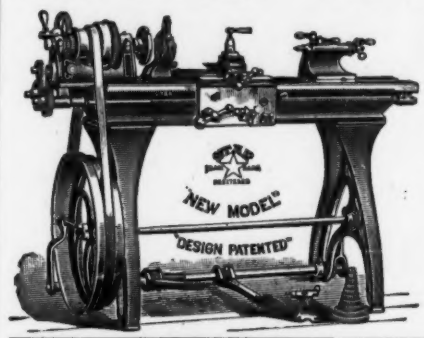

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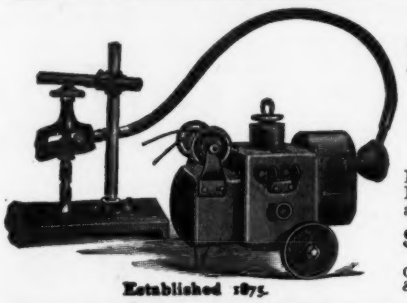

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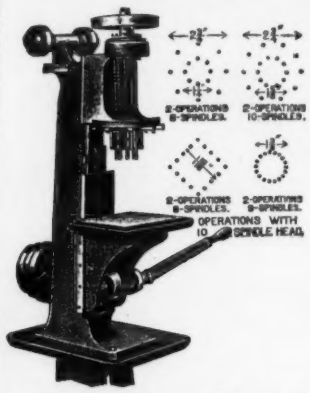

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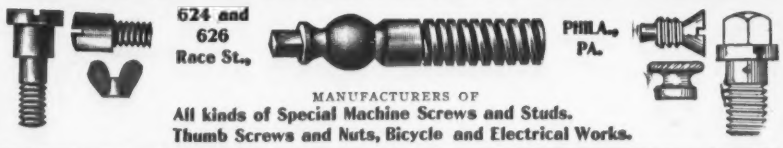

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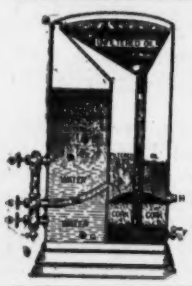

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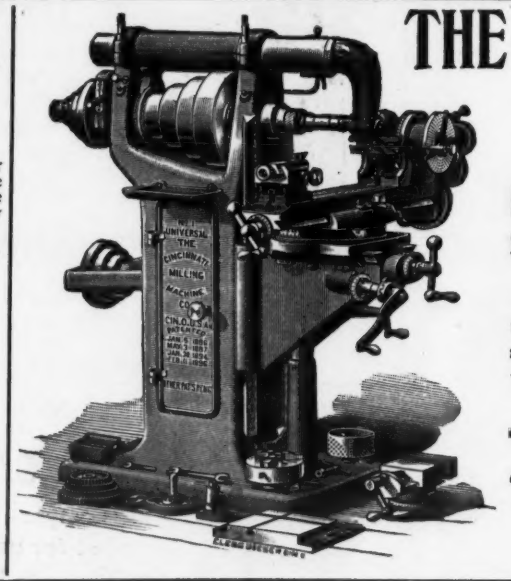

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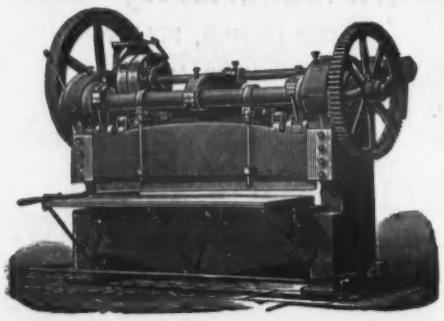

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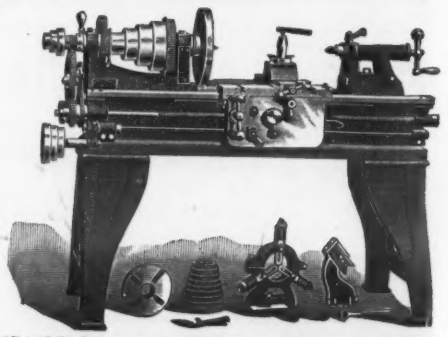

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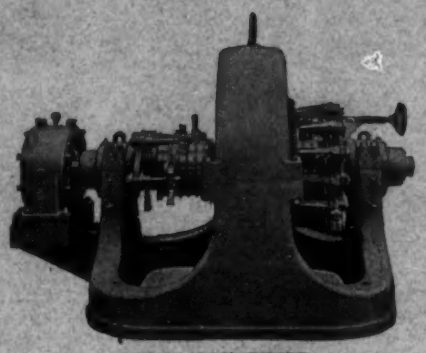

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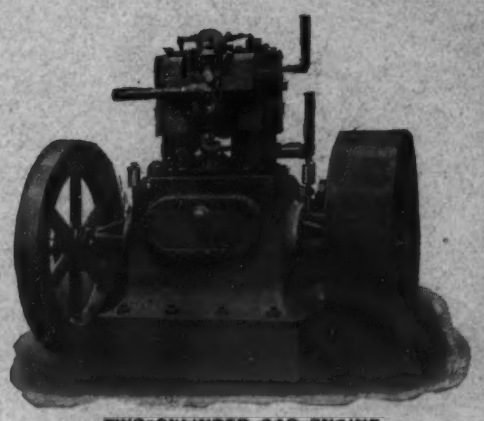

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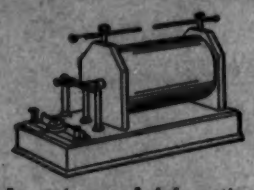

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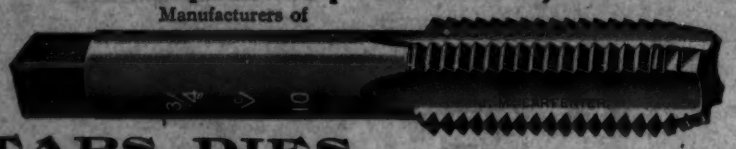

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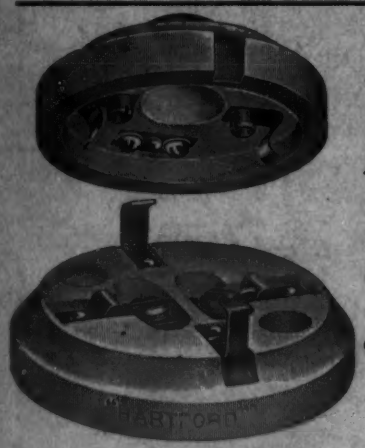

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